

The New Adventures of Archibald Higgins

The Spondyloscope

Jean-Pierre Petit



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The author



Jean-Pierre Petit, 68, retired (but still producing scientific works) is an astrophysicist specializing in theoretical cosmology. He spent 29 years in the Observatory of Marseille and wrote 32 books. Several of these have been translated into other languages, eight languages in all.

To find out more, visit his website

[http:// www.jp-petit.com](http://www.jp-petit.com)

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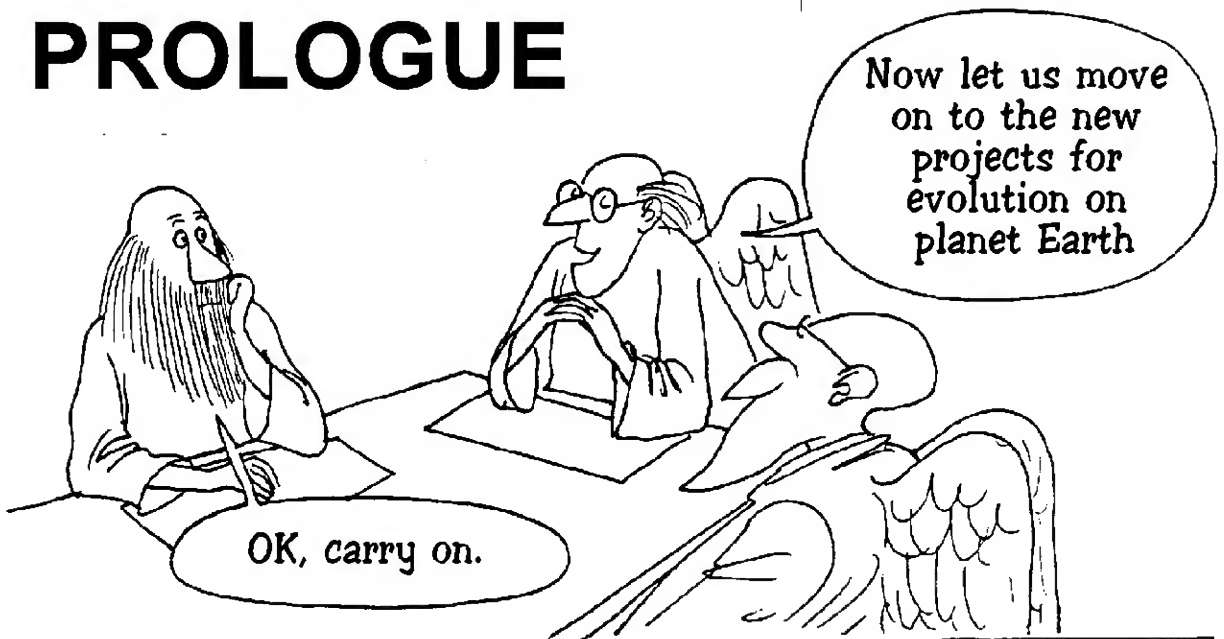
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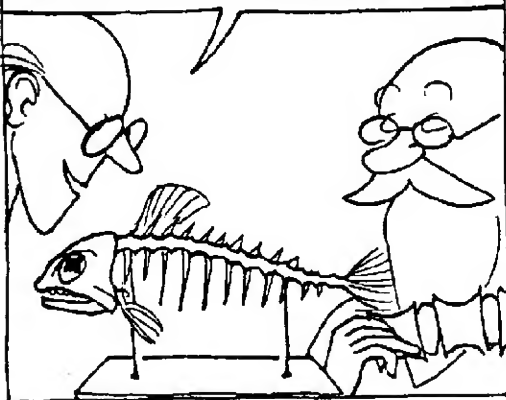
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This book is meant for anyone who has a skeleton

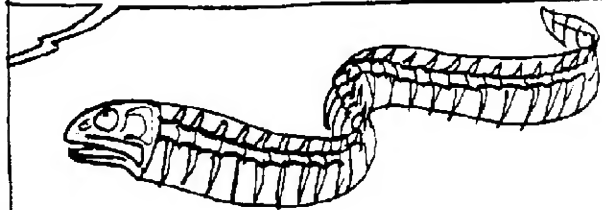
PROLOGUE



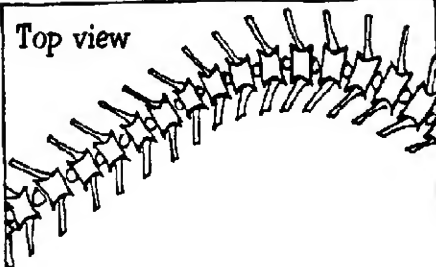
Let me briefly go over the main results obtained with the **SKELETON** of VERTEBRATES.



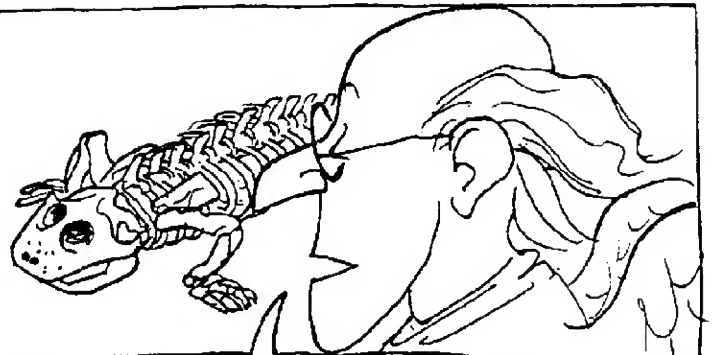
We have a series of fairly hard segments linked to each other by **INTERVERTEBRAL DISCS**, giving suppleness to the whole. The addition of the unitary flexions gives an important global flexion. Look at an eel for instance.



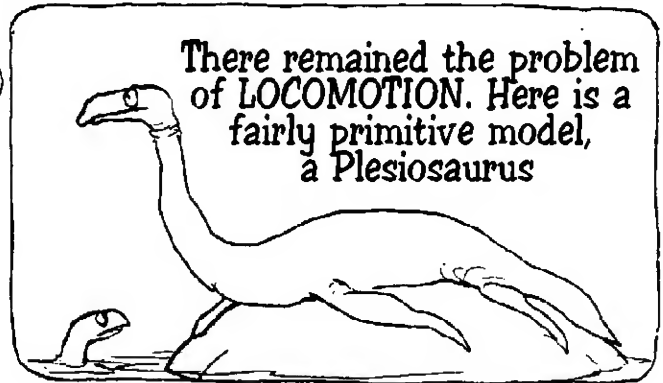
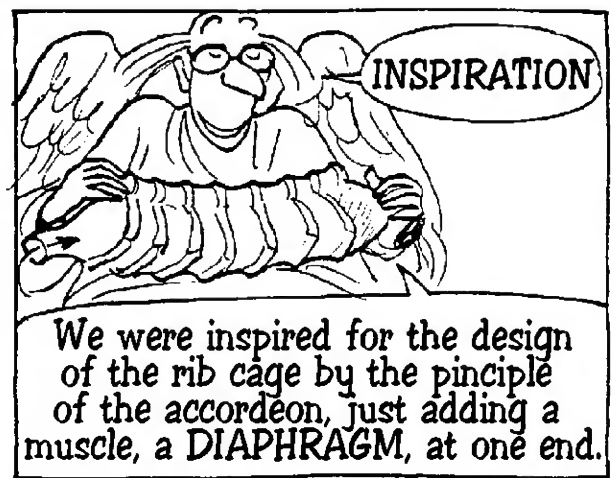
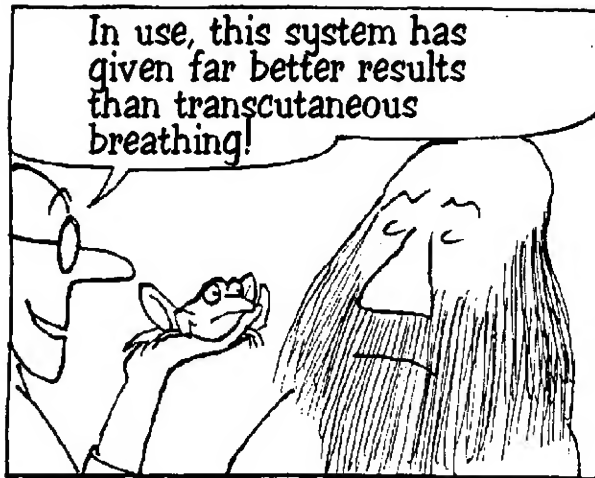
Top view



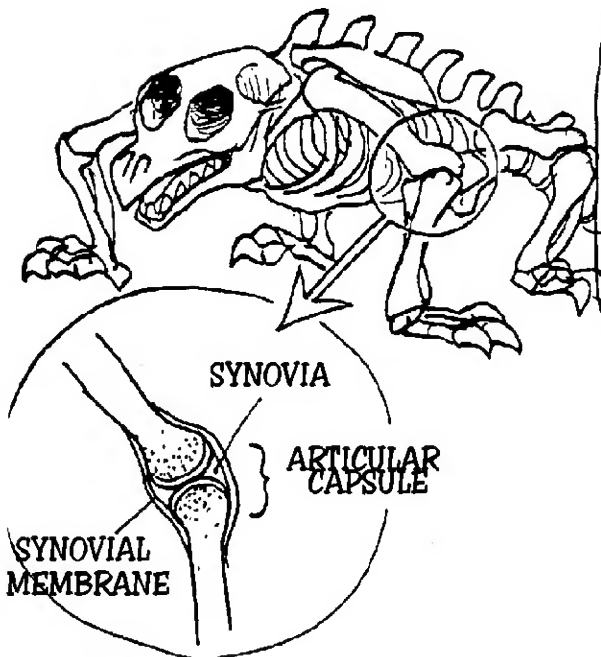
The ensemble is moved by a system of **MUSCLES** which are attached to bony protuberances called **APOPHYSES**.



After that, by folding the bones of fish, we were able to create an **ARTICULATED RIB CAGE** to allow breathing in air.



ARTICULATION



The conquest of dry land couldn't get underway until we had we had created **ARTICULATED MEMBERS** which were attached to the **SPINAL COLUMN** through the intermediary of the **SHOULDER BLADES** in front and the pelvis to the rear



To avoid wear we covered the two bone heads with **CARTILAGE**, made of other types of cells. This is surrounded by an oily liquid, **SYNOVIA**, which is secreted on the internal face of an **ARTICULAR CAPSULE** which ensures impermeability. This capsule is also attached to a system of **LIGAMENTS**. Cartilage isn't vascularised, but is nourished by **IMBIBITION**.

A real marvel!

CARTILAGE LUBRICATED BY SYNOVIA

ARTICULAR CAPSULE

But how does this **IMBIBITION** phenomenon work?

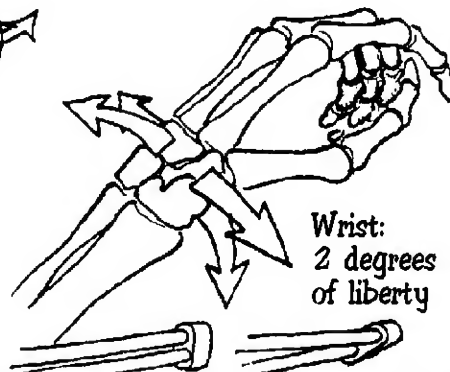
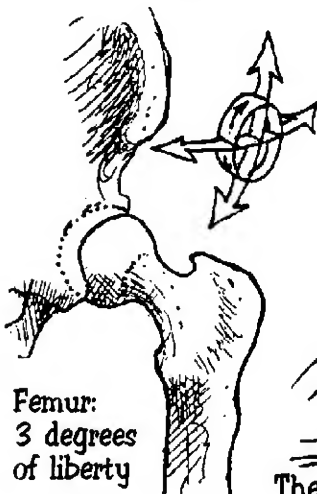
It's simple: When the animal puts its weight on its legs, the synovia is diffused in the cartilage through a simple effect of pressure

when it's at rest or sleeps, the cartilage exudes it, in that way there is an exchange of nourishment

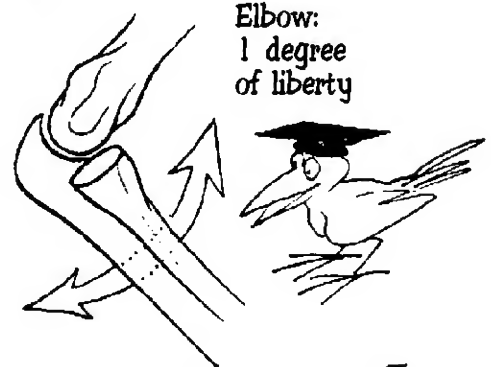


In certain cases one of the extremities of the bone serves as a receptacle for the other, which increases the articulation's solidity but limits its movement (such as the head of the femur).

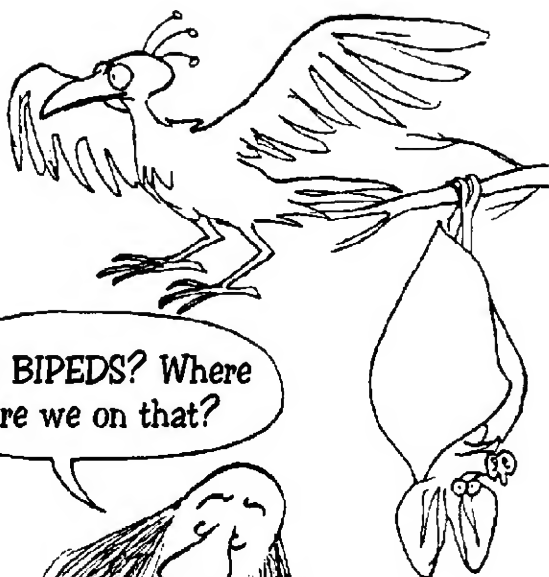
In other cases the degree of liberty is reduced, 2 for the wrist, 1 for the elbow.



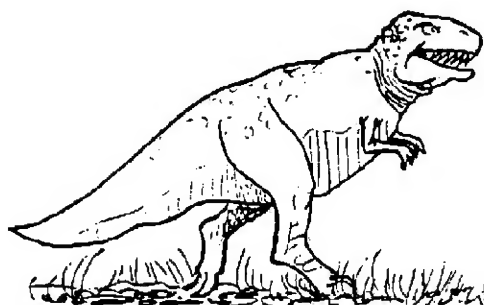
The third rotation is performed by the bones of the forearm.



The rear members were fixed to shoulder blades, themselves mobile, which led to several interesting innovations, such as birds and bats.



And BIPEDS? Where are we on that?



Well God, I must admit that our first tries weren't very encouraging. In order to balance the heavy Tyrannosaurus when it ran, we had to give it a tail that equalled a third of its bodyweight. It was hopeless at braking and the idiot had no idea what to do with its hands.

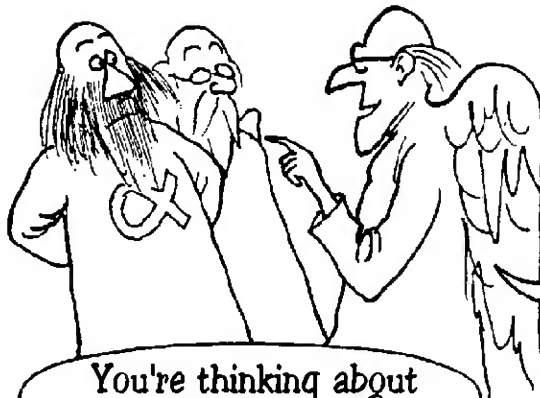
and it needs enormous muscles to move its tail

That's done it, I've broken a collar bone again.

and the Kangaroo, what did that give? I thought the Kangaroo wasn't bad.

Don't tell me you've been developing that old Kangaroo project! I've had complaints from their little ones, they say they get shaken up too much.

No, no, not at all. Forget the Kangaroo.



You're thinking about gathering food?

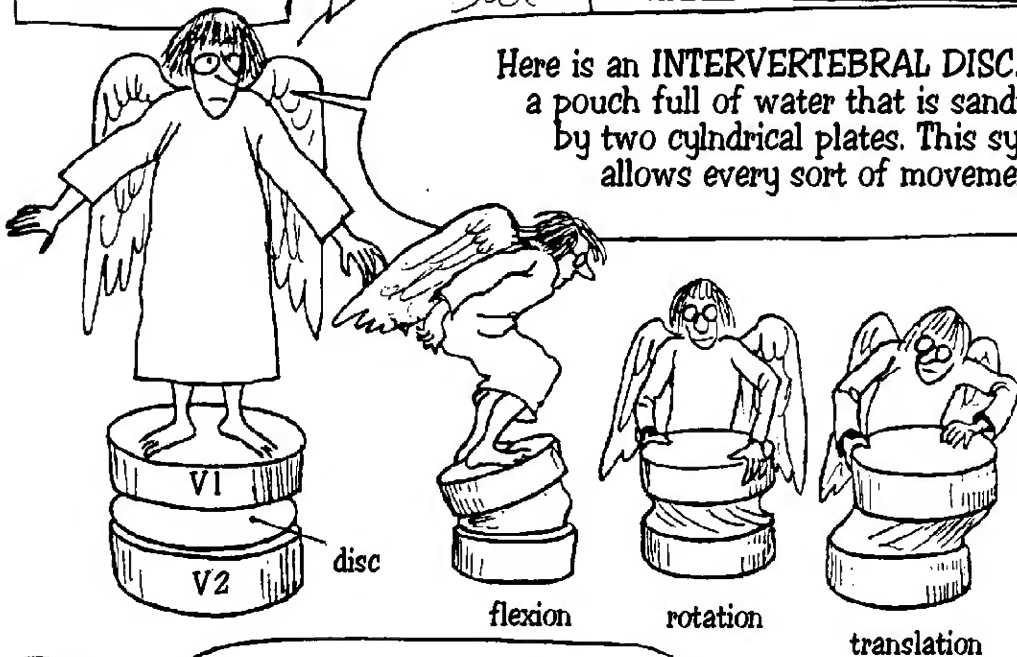
Let me go over the general idea: Being upright allows a better view over a distance, above the long grass of the savannah. This also frees the front members and allows them to be transformed into prehensile organs: **HANDS**. When the animal grasps something, it **SEES** what it does which seems very important to us. it makes it particularly apt for gathering food.



DISCS

Have you thought of the consequences of being upright for a long time? Your spinal column will have to work very hard. At pelvis level, the **LUMBAR VERTEBRAE** will have to support the combined weight of the torso, head and two arms!

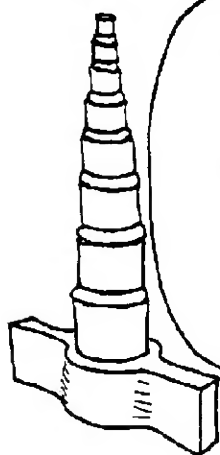
Here is an **INTERVERTEBRAL DISC**. Imagine a pouch full of water that is sandwiched by two cylindrical plates. This system allows every sort of movement.



Yes but the weight of the torso!
Have you thought of the weight and, especially, shocks?

I'm coming to that.





We arranged the vertebrae with the most massive towards the bottom and resting on the SACRUM (*). And as the head rests vertically on the spinal column, we need fewer muscles to move it.

but...when the animals moves?
Remember the Kangaroo.

Tch! Forget the Kangaroo. This animal walks, that is to say its weight is put first on one leg then on the other.

Yes but what do you do with the tail?

That's the thing, we take it away!

WHAT?

(*) The head of a man of 80Kg weighs 3Kg, the upper members 14Kg and the torso 30Kg. A total of 47Kg.

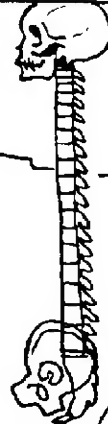


The arms of the Kangaroo and the Tyrannosaurus were too short and too light, so they needed heavy tails to maintain balance when walking or running (*). Here we lengthened and weighted the arms which can then play a role in balance

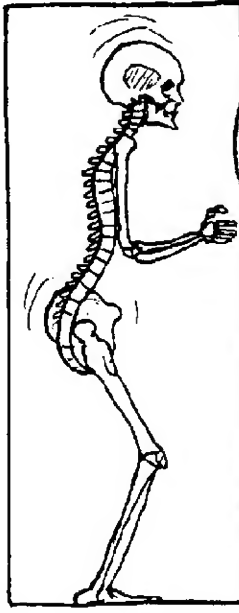
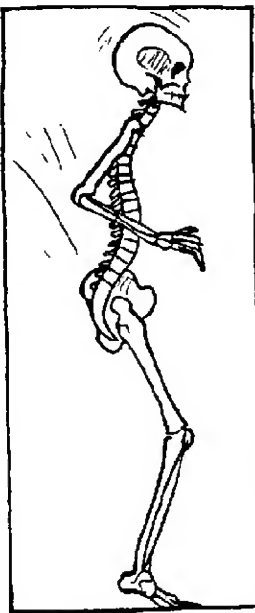
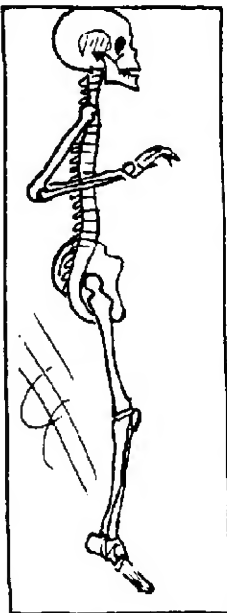


in short, the arms are being used like a tail?!?

But doesn't every step create a brutal shock for this spinal column?
After a few kilometres your animal will only be good for the breaker's yard.



There is a way to lessen the shock though,
by giving the column CURVES.



The column needs to be flexible to ensure a harmonious gait.

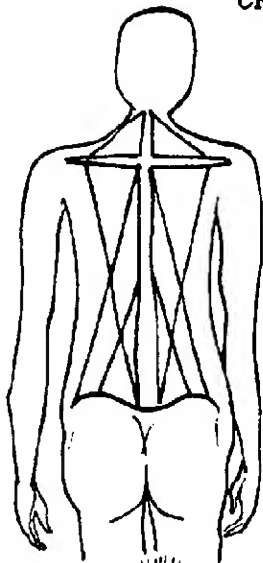


As I understand it, this system of sinuosities, curves, absorbs shock and delays DISC WEAR. But how do you stop this construction collapsing on itself?

(*) As the African Margouillat running lizard still does today.



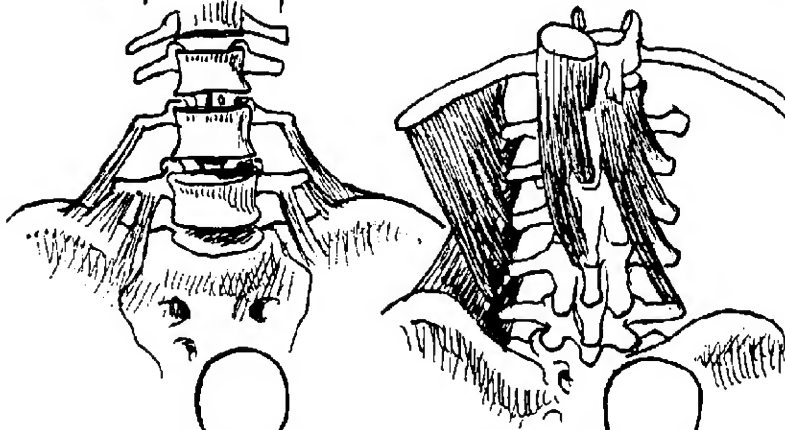
CROSSBAR



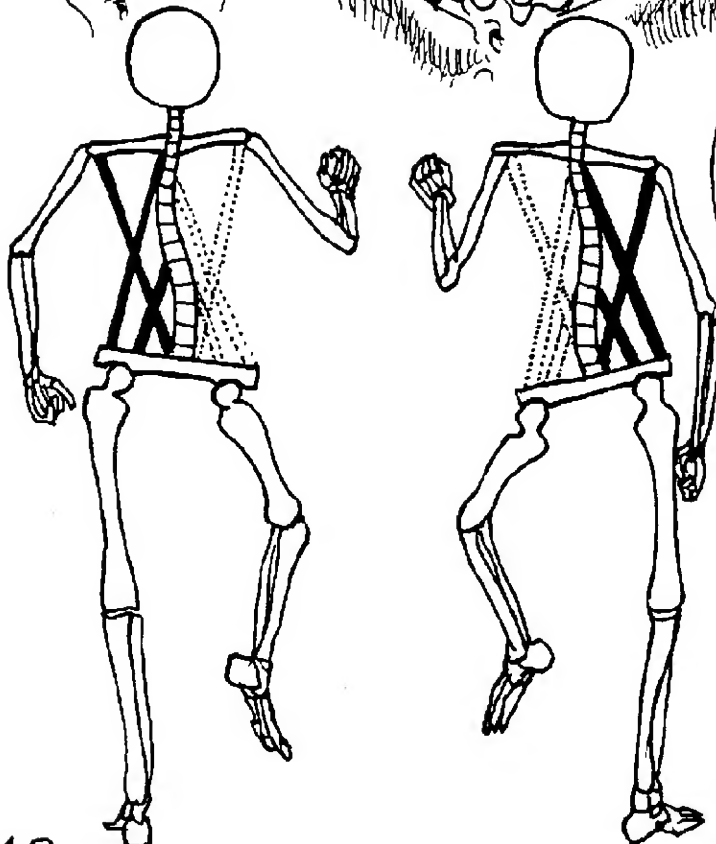
We gave the column **MUSCULAR SHROUDS** which are attached to everything that sticks out, the bony protuberances called **apophyses** on the **vertebrae**, the **RIBS** and the **PELVIS**.

OK, but in practice?

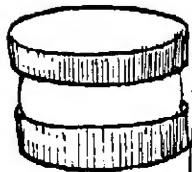
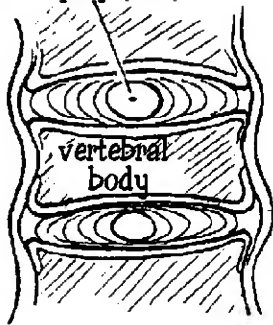
Here is an example of **SPINAL MUSCLES**



And here are the hip movements and differential muscle contractions which accompany walking or running.



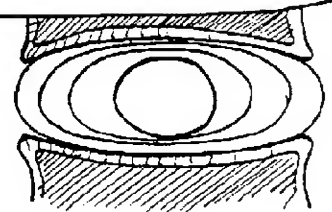
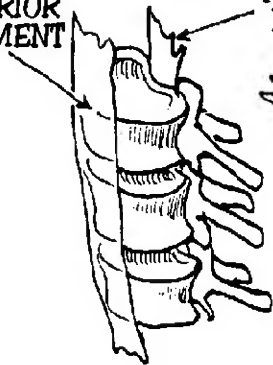
nucleus pulposus



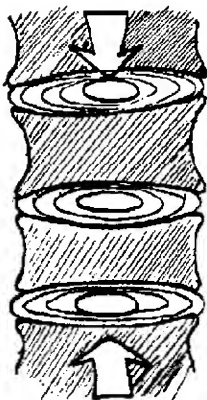
Each disc is an articulation. The vertebrae are covered by a cartilage. There is also a greasy liquid, **SYNOVIA**, and a fibrous capsule attached to the large ligaments which run along the anterior and posterior faces of the spinal column.

ANTERIOR
LIGAMENT

POSTERIOR
LIGAMENT



When the human body is lying down or in a state of **WEIGHTLESSNESS** (swimming pool, space) the nucleus takes on a spherical shape. It is made up of 98% water, semifluid, comparable to the crystalline lens of the eye. This is contained in a series of fibrous capsules, which are a little like the layers of an onion, and are composed of interleaved fibres which imprison the nucleus in the solid net they create.



So in short, it resembles an **OLEO-PNEUMATIC** suspension system. But how do you nourish these discs?

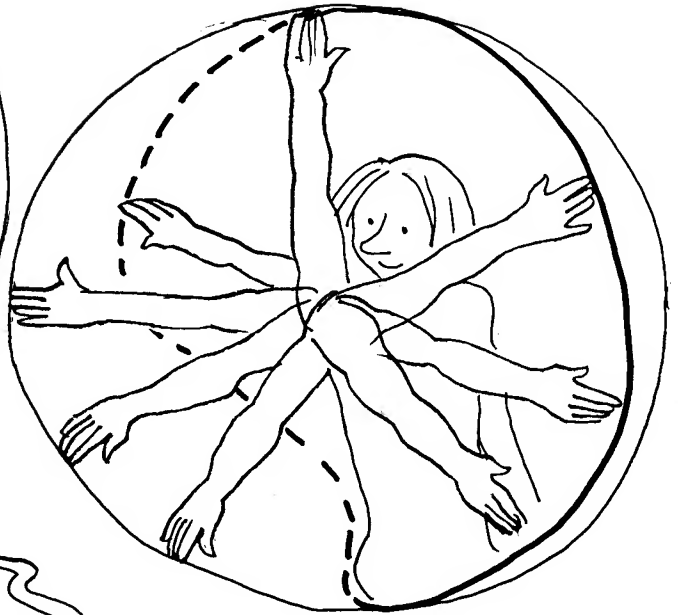
By **IMBIBITION** as usual. During the day the excess liquid passes into the spinal column. During the night the body rehydrates the disc and its nucleus by giving it proteins etc...

You understand of course that it was impossible to put fragile blood vessels into elastic elements such as these which are subject to high stresses.

That means these creatures have to move all the time!

THE SHOULDER

I'm confronted with a biomechanical problem. You can't imagine what this animal has to be capable of doing with its two arms!



Your thing can't possibly work! You're in favour of modernity but all you've done is put front paws on a horse and you think your animal will be able to climb trees with that!..

In my opinion you'll have to completely redo the geometry of the shoulder blade, make it more mobile by detaching it from the rib cage. A lot of muscles and ligaments need to be added too to allow these new movements

SCRONCH SCRONCH



Well yes, man is definitely not made to be sedentary. If he does become sedentary, his intervertebral cartilage, his discs, will dehydrate and degenerate

And I suppose that this animal is intelligent enough to understand that.

We have given it a brain in consequence.

All the same, it seems very much like amateur DIY to me. This column in a zigzag, resting on the SACRUM and capable of tilting between 30 and 45°, do you honestly think it will hold up?

It's a DYNAMIC concept, a question of balance between the force of the ligaments and the stresses imposed on them.

Remember, in the beginning we made superstable but hyperrigid machines which had great difficulty walking, let alone doing it well!

We have to be modern these days!

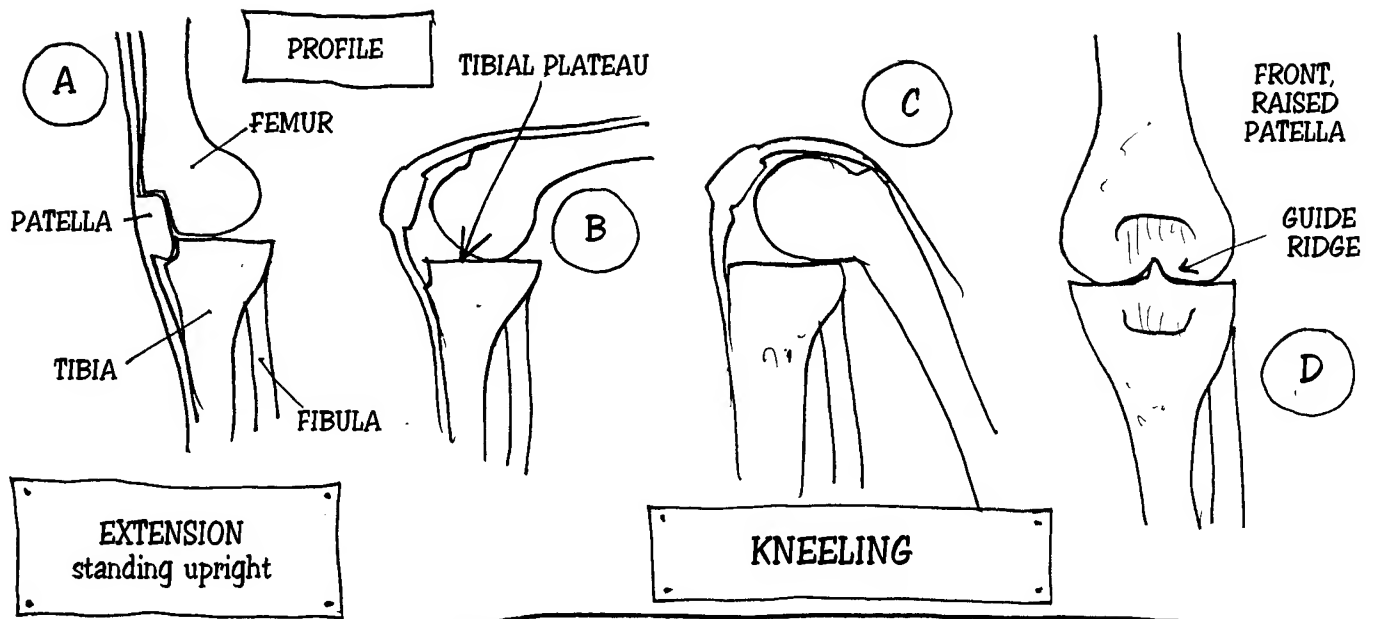
CERVICAL

DORSAL

LUMBAR

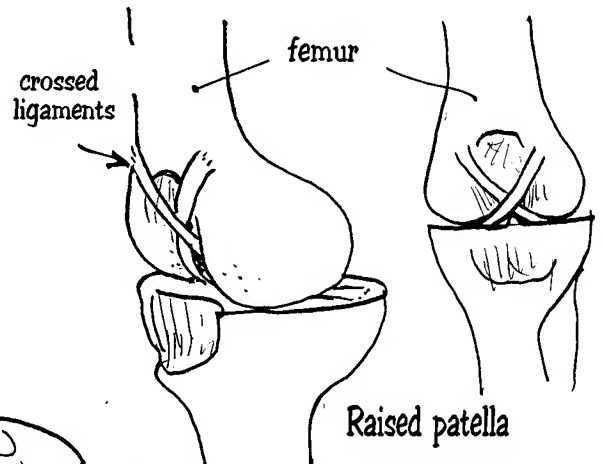
SACRUM

PELVIS

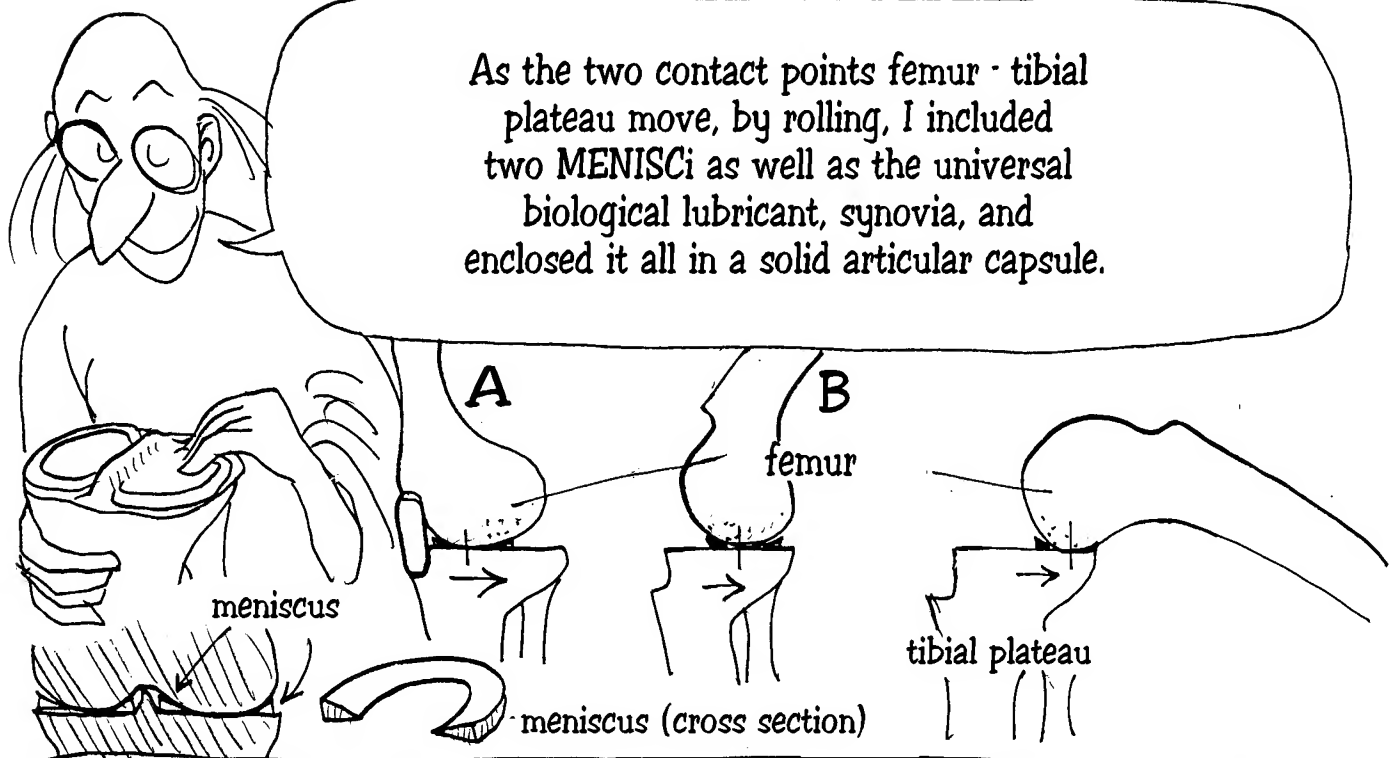


I'm quite pleased with the **KNEE**. The base of the femur turns on a **TIBIAL PLATEAU**. A guide-ridge (**D**) stops the leg from going in all directions and permits **WALKING**. The Patella, at maximum extension (**A**), blocks the leg and stops it folding forwards. It also acts as a secondary pulley which means the creature can play football.

But how do you deal with the junction between the femur and the tibia and manage the friction?



That's all down to the **CROSSED LIGAMENTS** which ensure a nice tight junction and stop the animal losing its tibia when it runs.



Don't you ever worry that these menisci will block in the folded position? (*)



Ruined menisci

Well they aren't indispensable anyway, the animal can live quite happily without them, so if they did become a problem they could be removed.

I see you've put loads of crossed ligaments in the shoulder going in all directions.



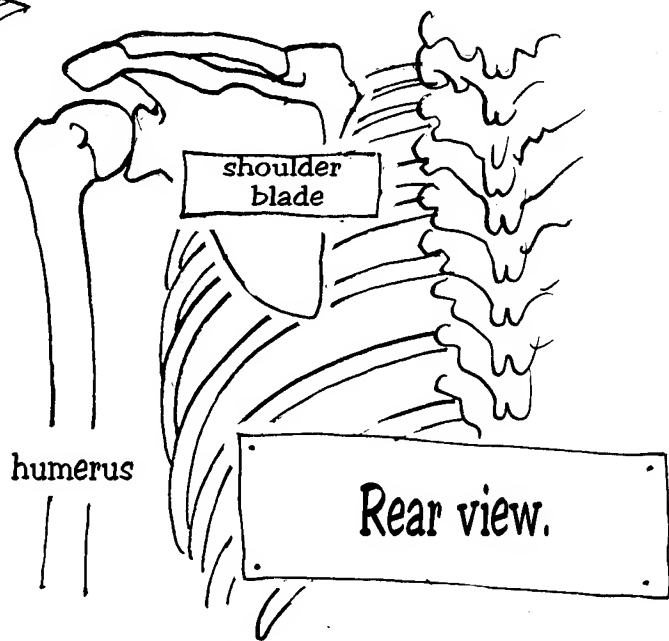
(*) A problem for tilers, who spend too much time on their knees.

end stop
pelvis
femur

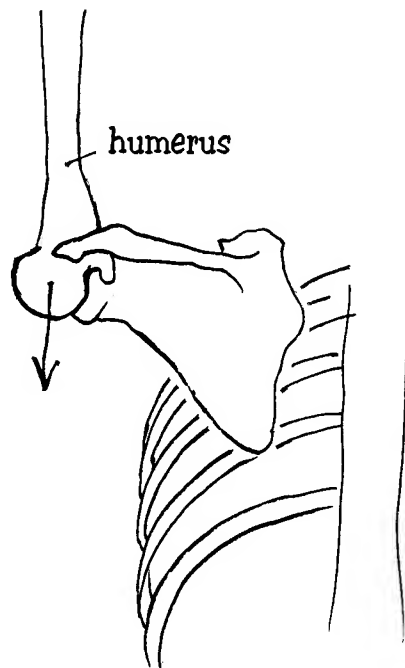
but by requiring such arm mobility in relation to the torso, it's impossible to turn the head of the humerus in a cavity as closed and spherical as that designed to receive the head of the femur.



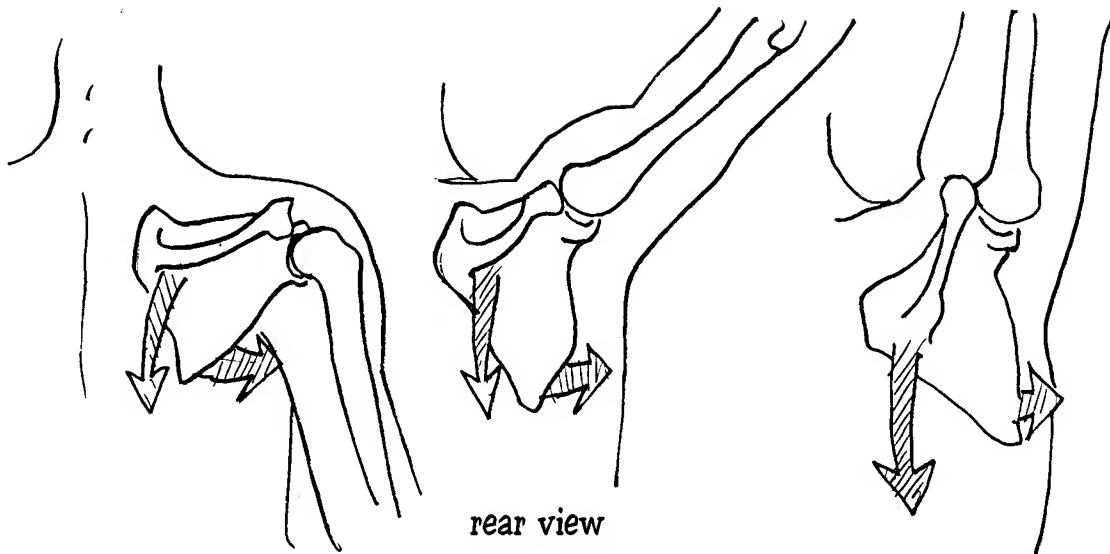
Yes, the more spherical the head of the humerus, the more the surface of contact on the shoulder blade will be reduced to a shallow cavity.



I can see a problem: when your animal wants to raise its arm it will come off and fall into his underpants !



no wait, wait...

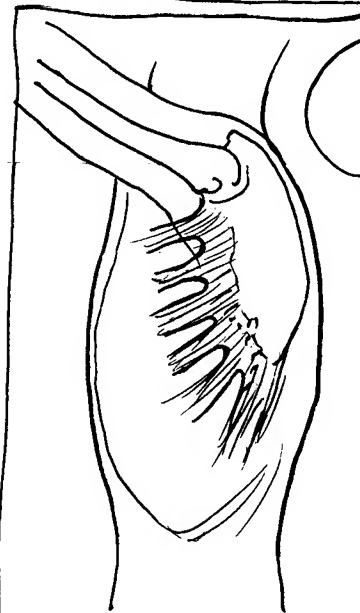


rear view

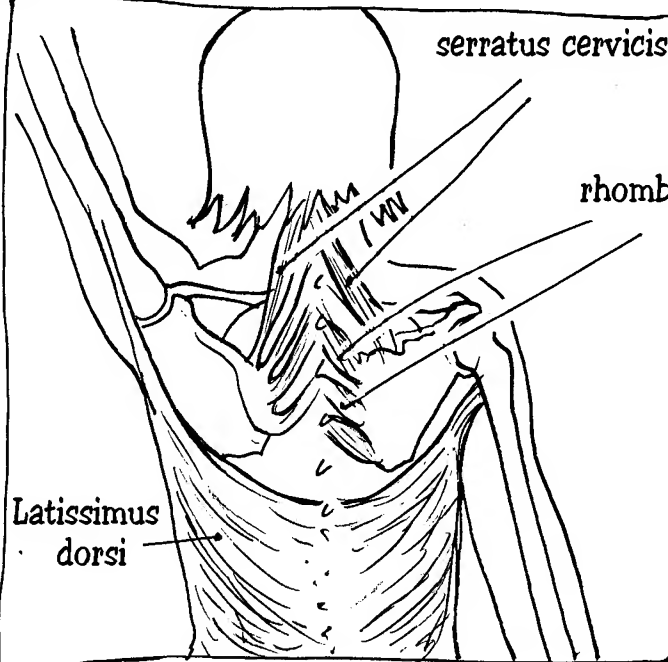
moved by a complex system of muscles, the shoulder blade will turn in a way that ensures that the surface of contact with the head of the humerus is always be able to support the effort.



These muscles form sheets that slide over each other.



The **SERRATUS MAGNUS** attached to the ribs, lowers the shoulder blade



serratus cervicis

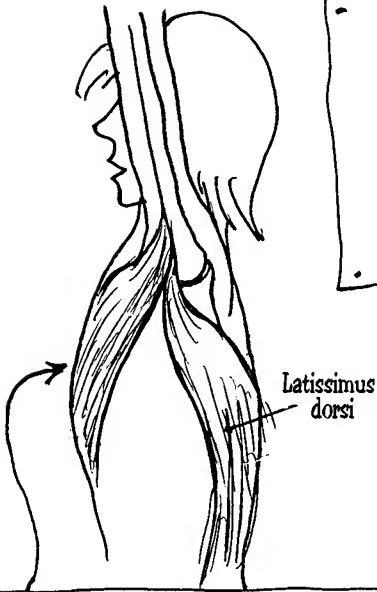
rhomboideus

Latissimus dorsi



The rhomboideus and trapezius muscles raise the shoulder blade and the **LATISSIMUS DORSI** makes it possible for the creature to climb trees.

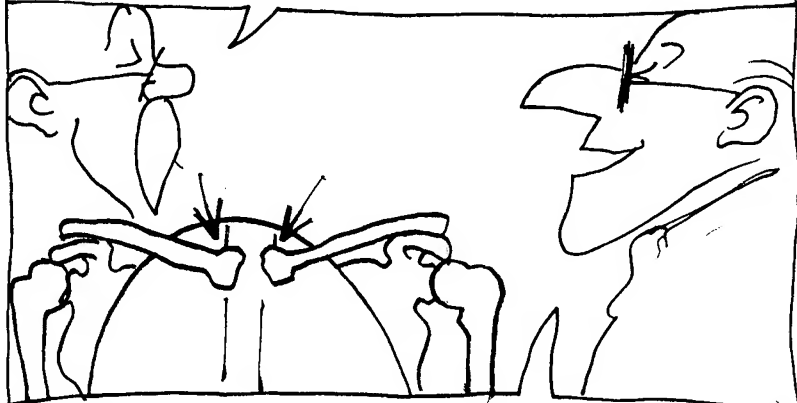
Elephants and horses are poorly equipped on this point (mobility, muscles) which is why they can't climb trees



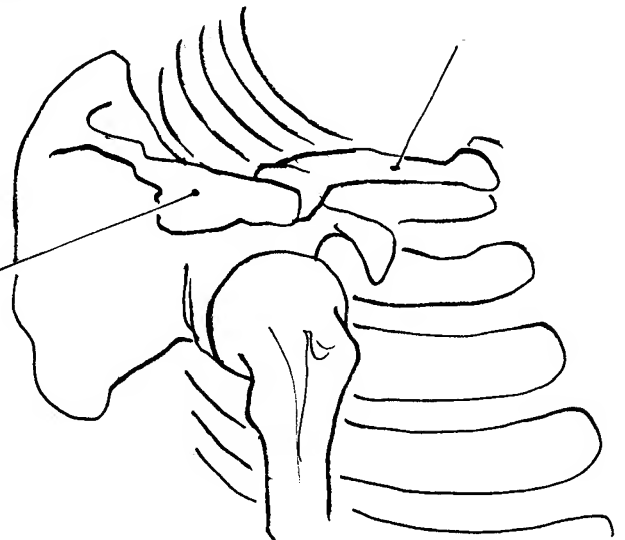
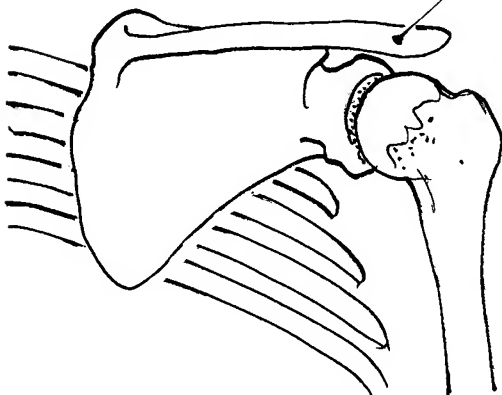
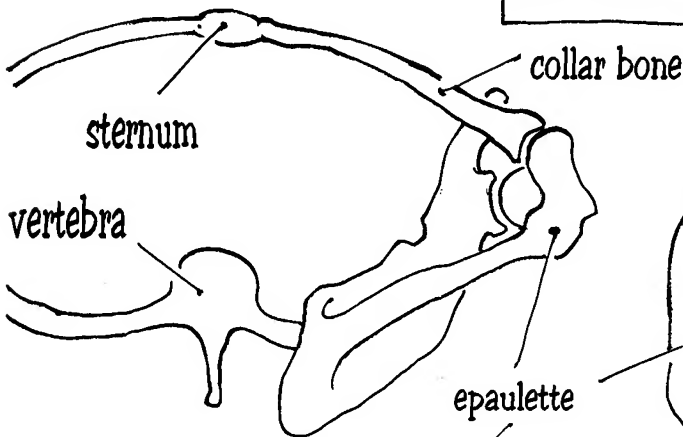
It is assisted by the **PECTORALIS SUPERFICIALIS**

The shoulder blade surrounds the rib cage

So in short, your shoulder blade becomes a floating bone in the animal and is just held on by muscles.

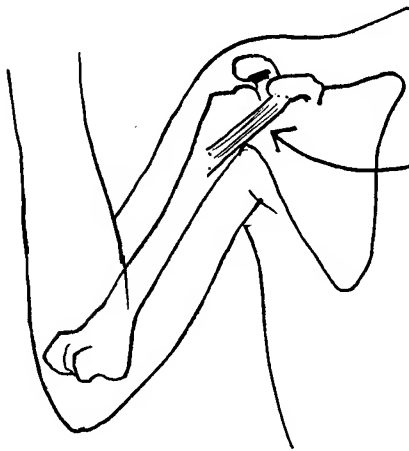
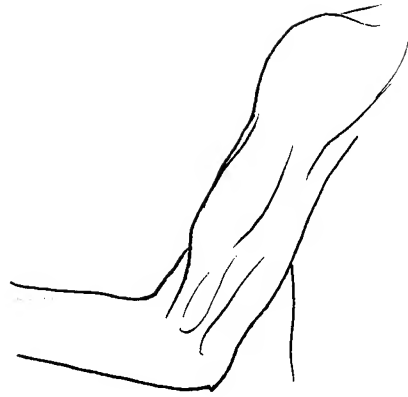
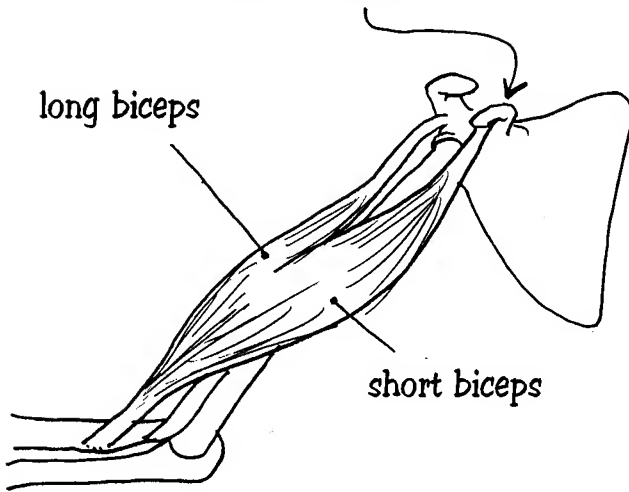


No, there is a fixed point, at the junction of the collar bone and the sternum, the only one though.



It has several bony protuberances which only make sense when we realise that they are used for attaching muscles.

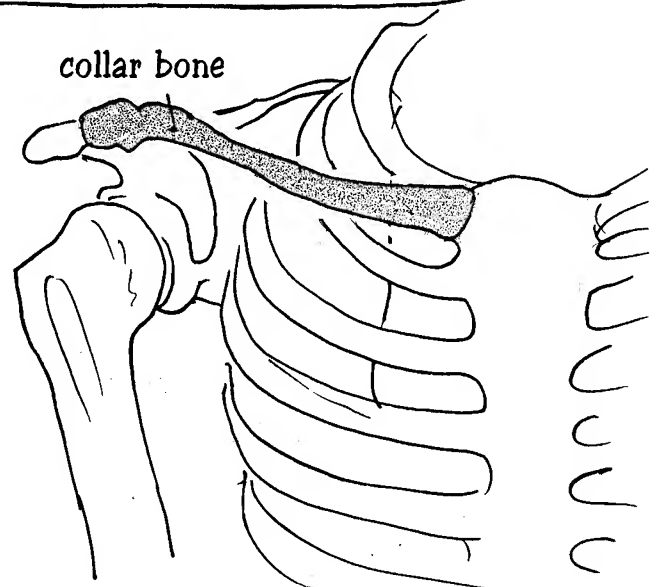
The short biceps is attached to the caracoid apophysis



and to the coraco brachialis,
otherwise we couldn't stretch

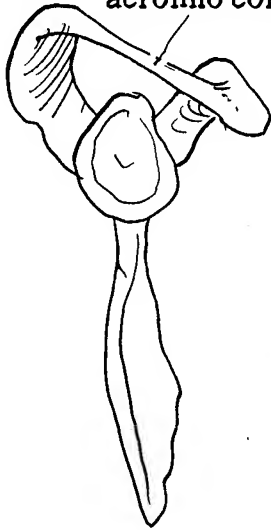


The collar bone is fixed to an apophysis

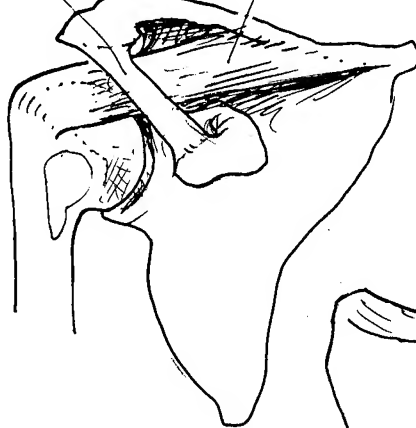


A ligament links the two main shoulder blade apophyses with a muscle, the SUPRASPINATUS

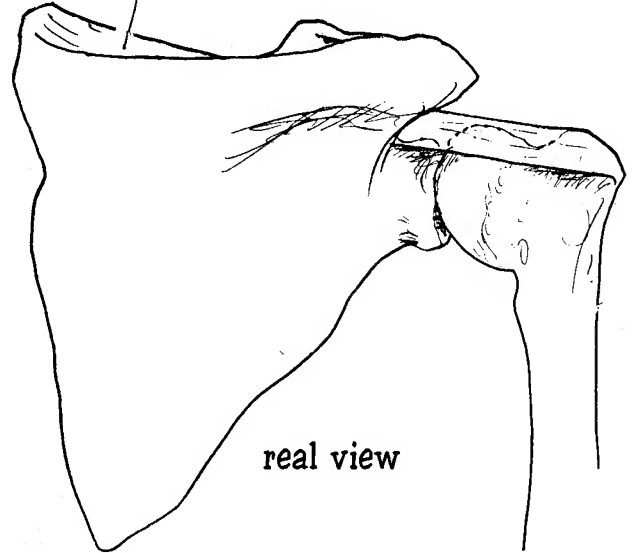
acromio-coracoidian ligament



end view of
shoulder blade

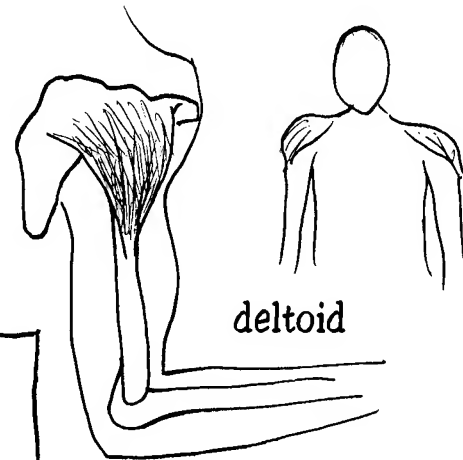


front view



real view

This muscle plays a key role in military activities as a 'starter'. It initiates the arm-movement necessary to salute a superior. The DELTOID muscle, which covers all the top of the shoulder, takes over and deals with the rest of the movement.

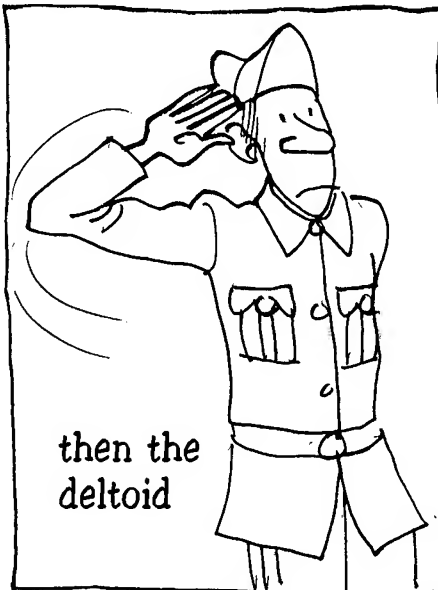


deltoid

Supraspinatus
in action

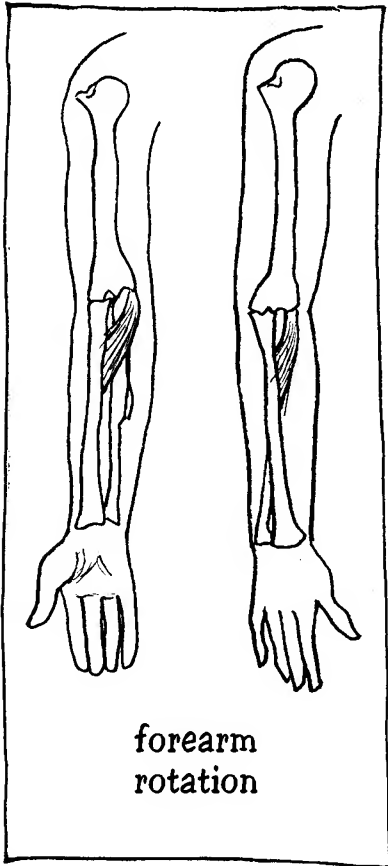


then the
deltoid



THE WRIST

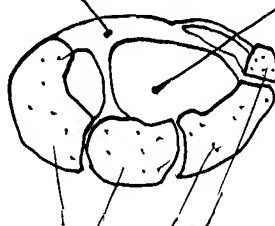
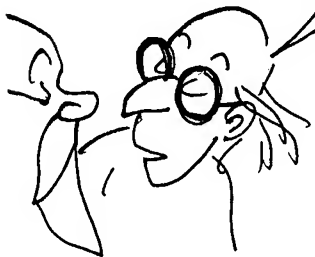
Arms are not only used for balance during walking. When immobile the animal can use it's extremities to grasp and manipulate objects.



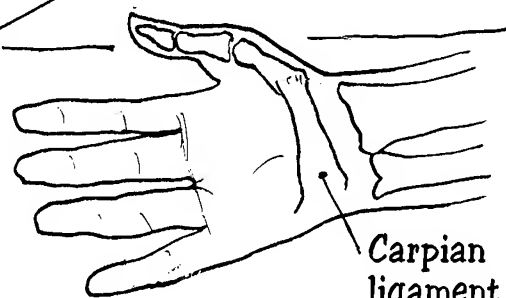
Saddle-shaped surface of contact in the thumb's articulation so that it can be made opposable



I must admit it took me some time to find a method for passing the nerves and blood vessels for the control system of the HAND. The solution was to organise the wrist bones as a sort of drain, closed by the **CARPAL LIGAMENT** and forming the **CARPAL CANAL**.

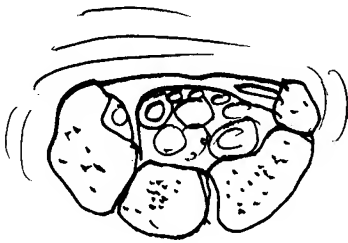


Wrist bones

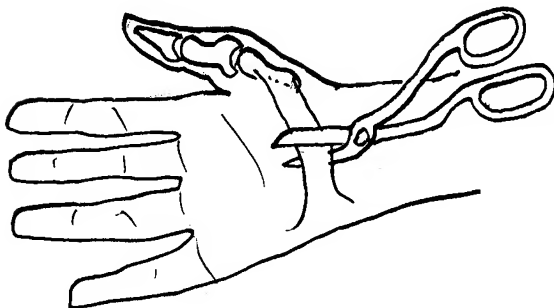


Carpian ligament

This ligament, which is shaped like a wristwatch, has a tendency to shrink with age among certain subjects.



this compresses the nerves and can even damage them over time if not operated on quickly. As blood circulates badly, the subject feels numbness in the hands and on they are red and swollen.



The problem can be solved by cutting into the hand, under a local anaesthetic, and then cutting this ligament. The decompression of the nerves gives an impression of a strong electric shock.



This operation to UNBLOCK THE CARPIAN CANAL is perfectly benign and a few months later the hand has full functionality once more.

MAN

So, how's the project going?

Very well! He is able to gather now. Look, he can grasp apples on trees

But that wasn't part of the project! What's he doing?



How many are there on top of each other?

I make it four

of course not, the bodies of vertebrates are very solid. They can support up to 500 Kg. As for the nucleus, that can support pressures of up to 1400 Kg

but it's terrible!

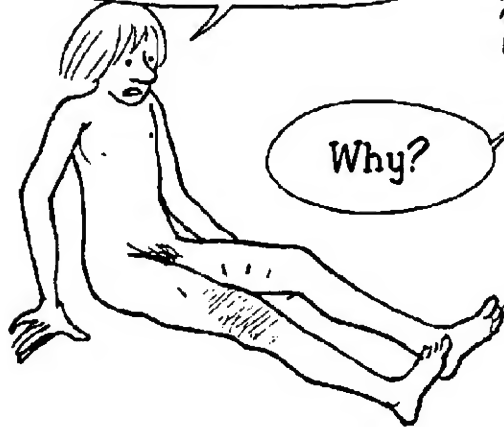
You wouldn't think so at first glance but it is an excellent machine.

What are you doing?

Come down, we've got enough apples now.

SPRAINS

It's swollen and red and it hurts.

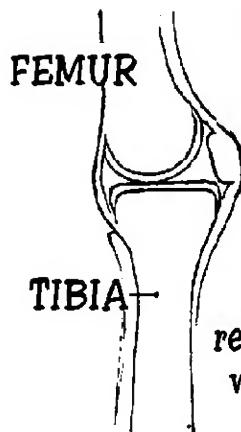


Why?



Ouch, blow!

He put too much strain on the ligaments that's all. They are highly innervated and irrigated. That's why it hurts.



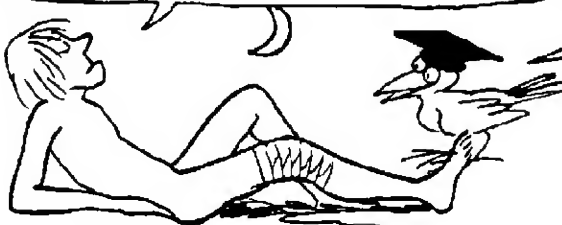
The swelling (oedema) comes from pressure caused by an accumulation of liquid in the articular capsule. This is a defence mechanism to limit articular movement. The high inflow of blood causes redness and heat when combined with certain chemical reactions that take place.



2 to 3 weeks rest without moving



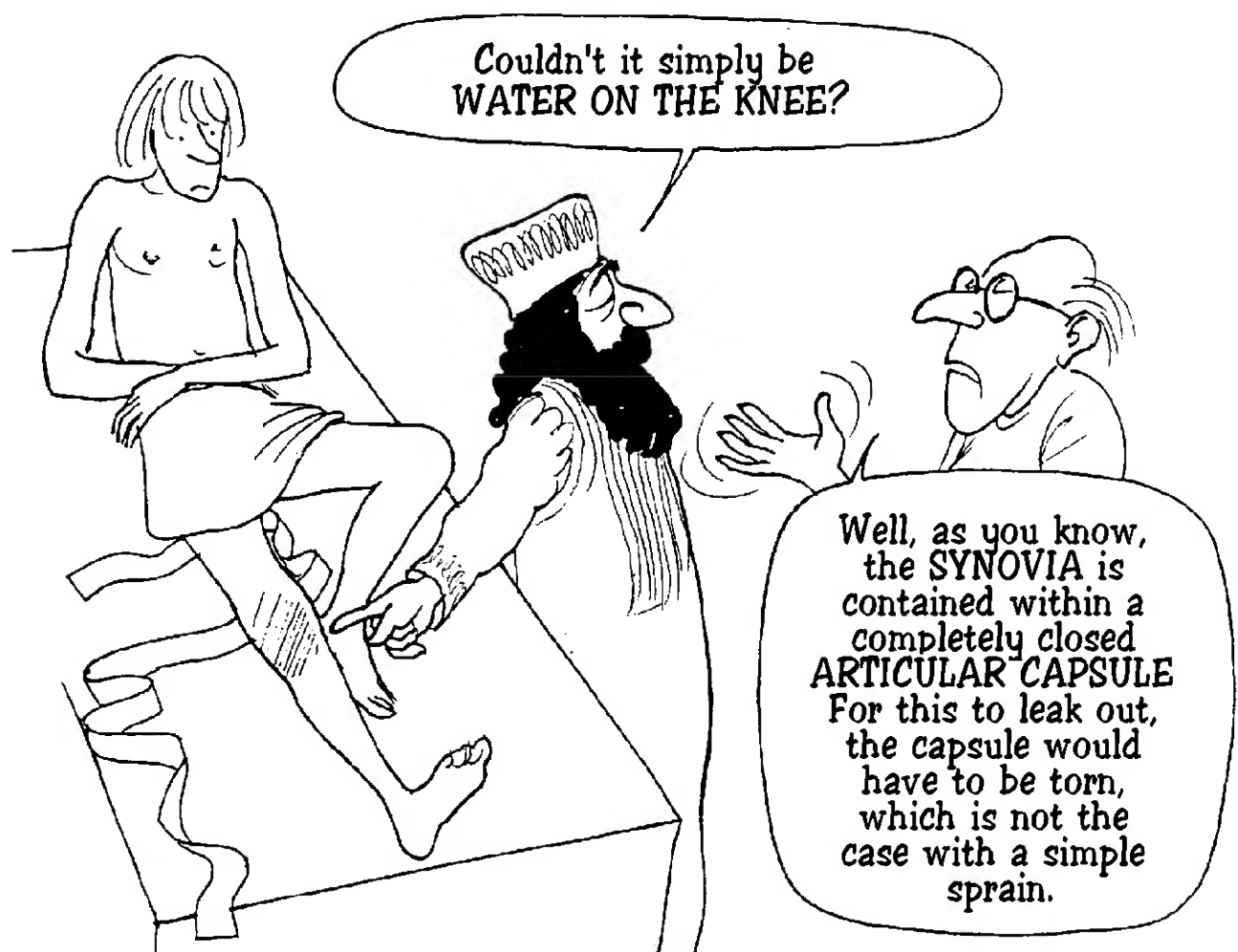
Why does it hurt more during the night?



Because the body secretes natural anti-inflammatories whose production rate drops to a minimum when the body is at rest.


but we can also use anti-inflammatory drugs.






Couldn't it simply be
WATER ON THE KNEE?

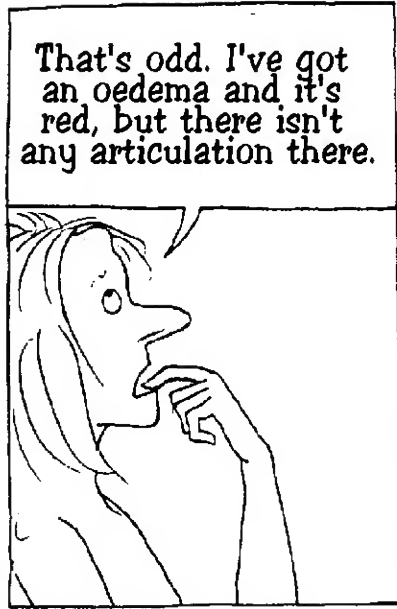
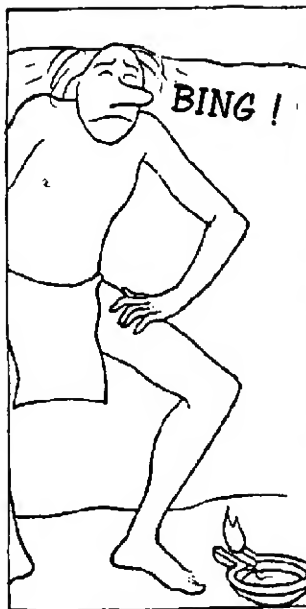
Well, as you know,
the **SYNOVIA** is
contained within a
completely closed
ARTICULAR CAPSULE
For this to leak out,
the capsule would
have to be torn,
which is not the
case with a simple
sprain.



It is the influx of humour and lymph
into the articulatory capsule that
creates the swelling, but synovial
leaking, housemaid's knee, is a myth,
nothing else



But I thought that...



swelling, redness and the influx of blood are all part of the organism's emergency reaction to immobilise the articulation. After a bump it brings 'workers' to 'repair the damage'. If there was also a sting, or a splinter for instance, that would be supplemented with an immunologic reaction

The Management

And when the phenomenon concerns the entire body we call it a FEVER

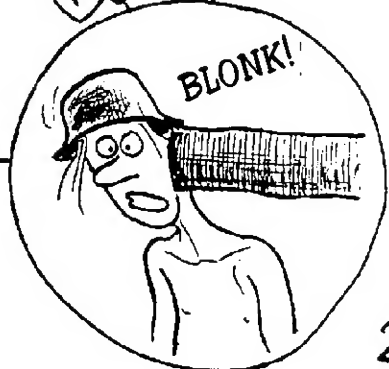
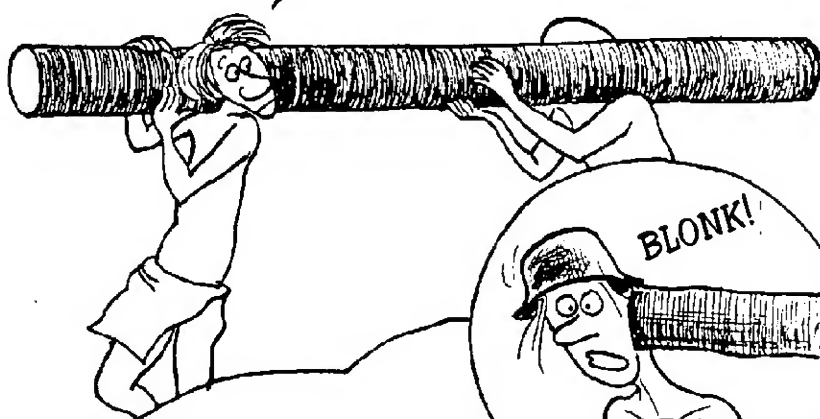


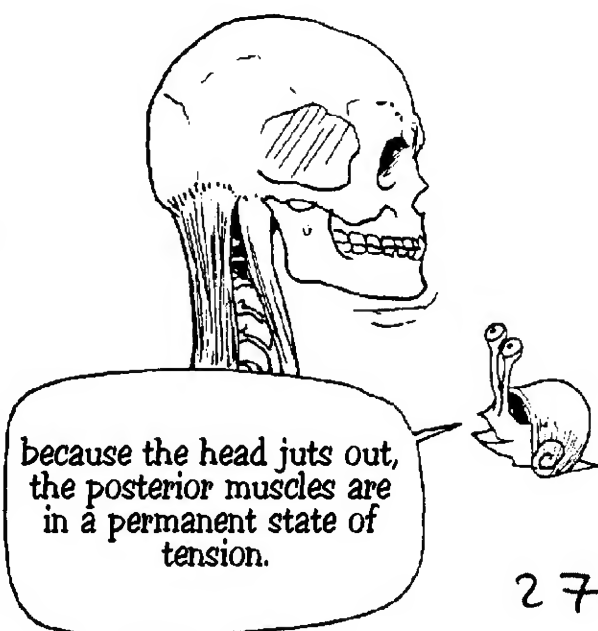
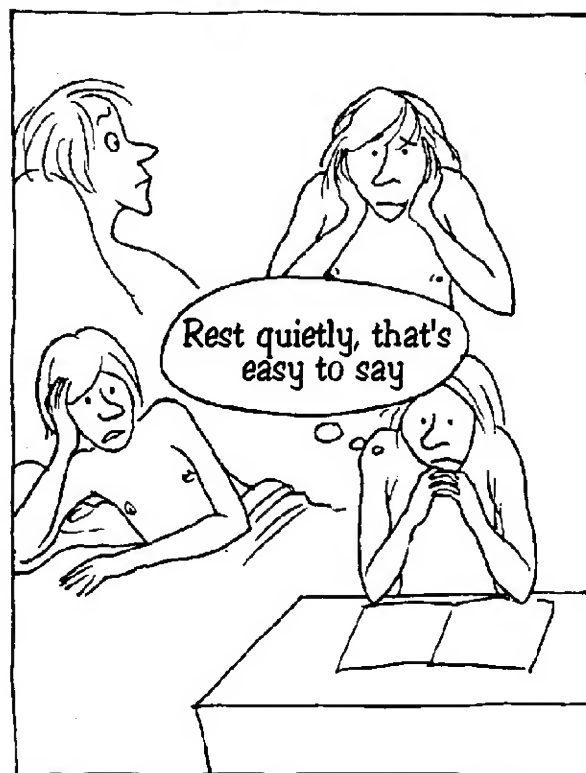
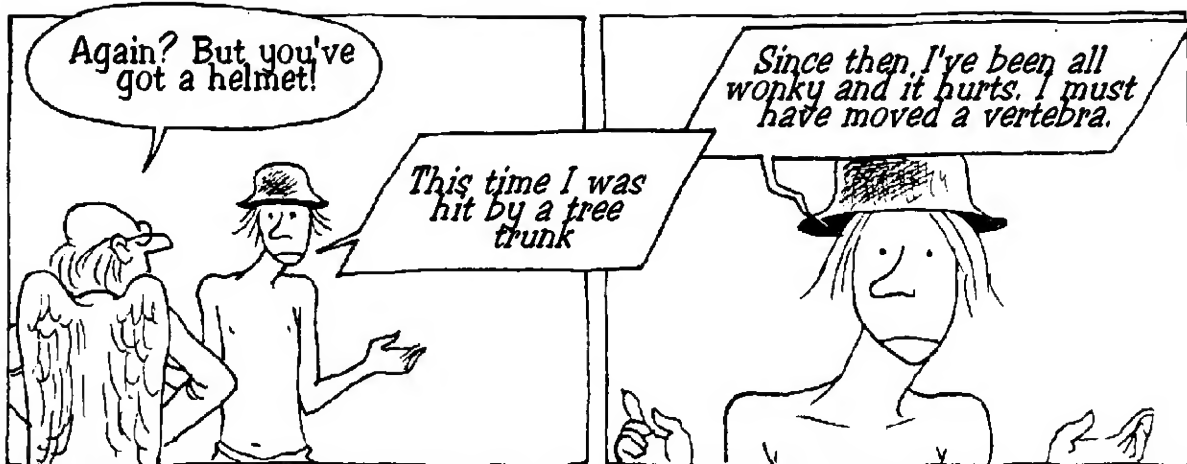
So what's a twisted ankle or wrist then?

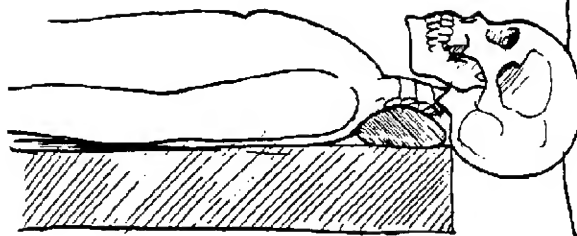
Much the same. Then is usually a case of a stretched ligament whereas with a sprain there is some amount of detachment of the ligament. It's very painful because it is very innervated.

With this it won't happen again

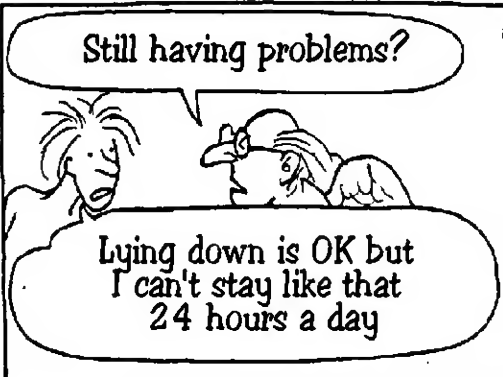
slow down, I'm slipping



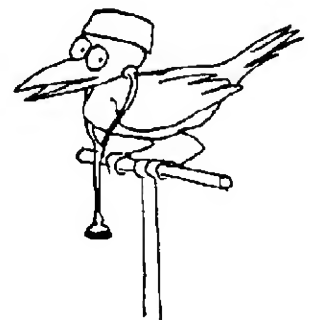




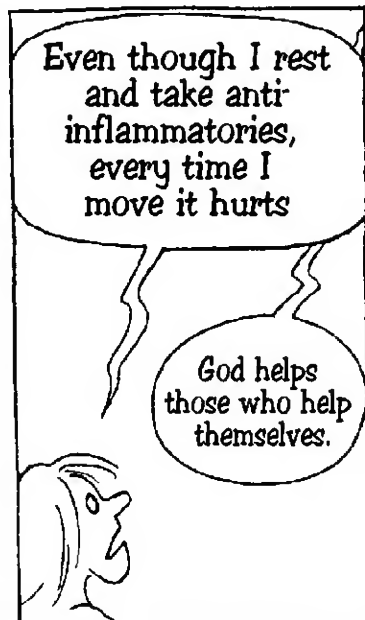
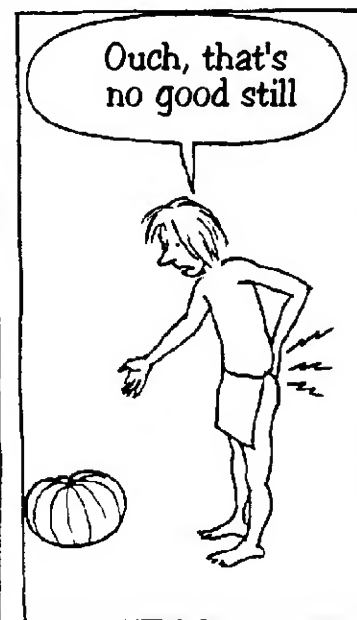
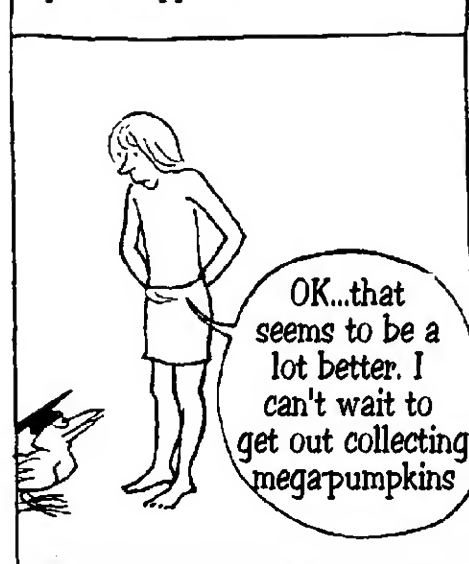
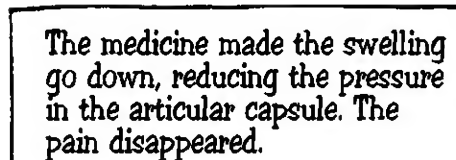
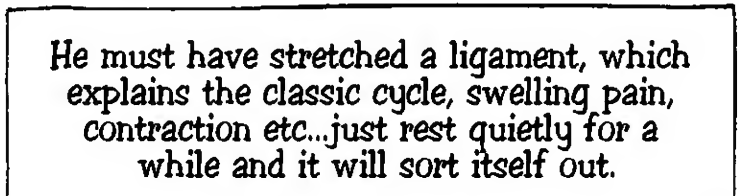
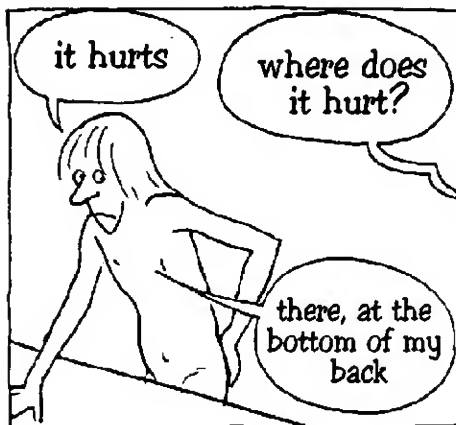
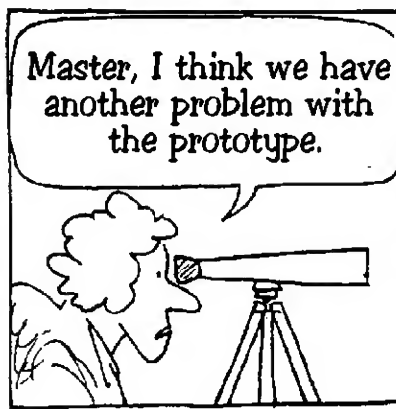
The only way to really rest the head is lie down with it slightly overhanging the end of the bed, so applying a slight traction to the cervical column, and aligned to the body's axis, with all muscles relaxed.

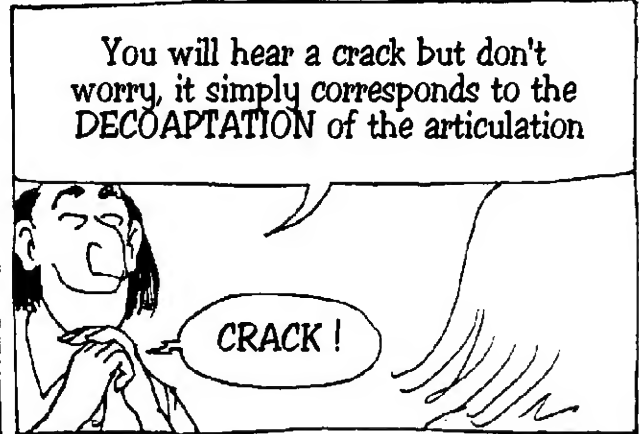
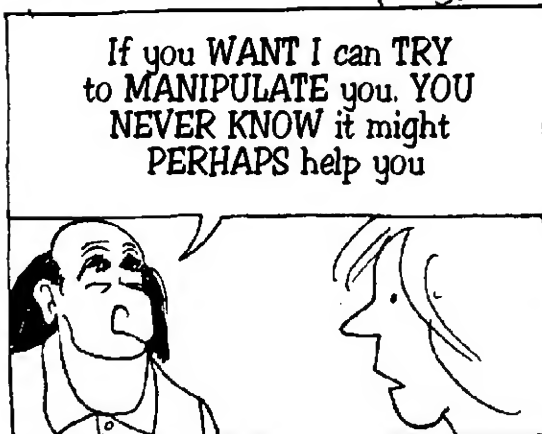
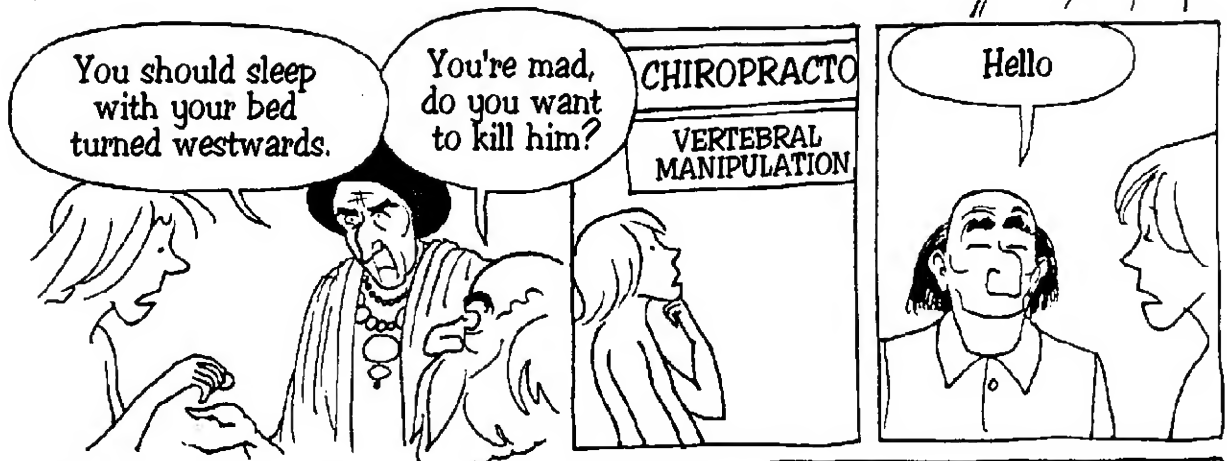
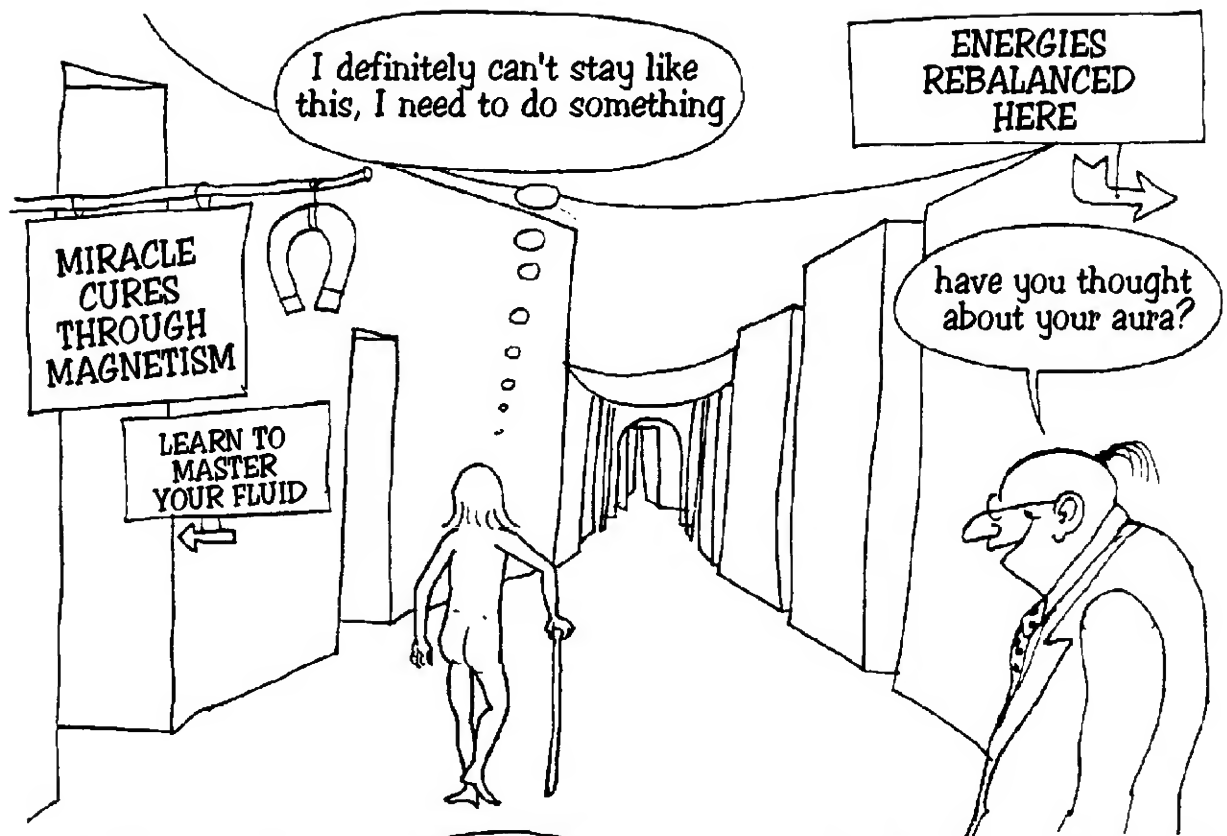


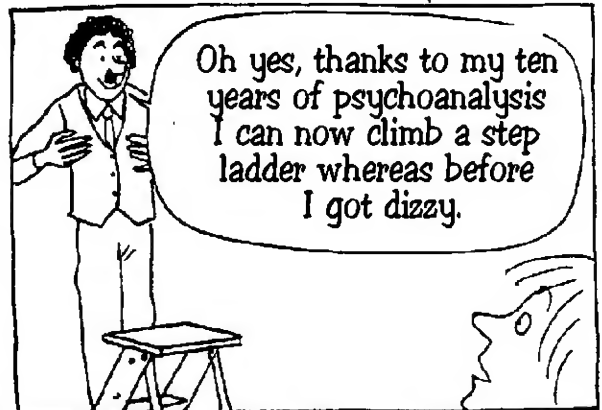
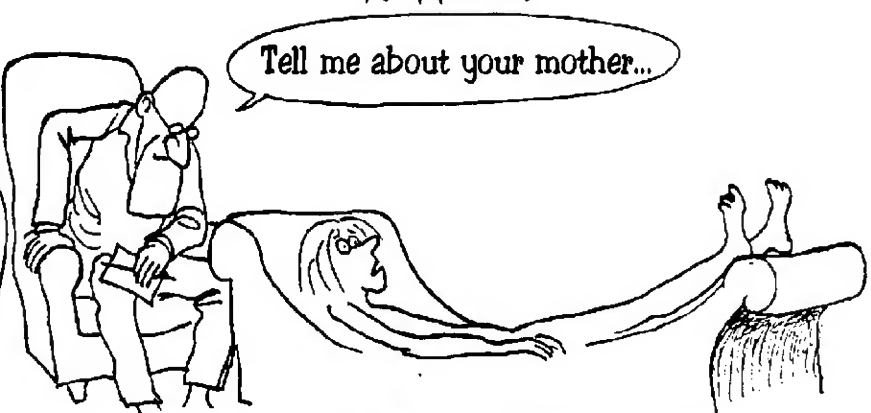
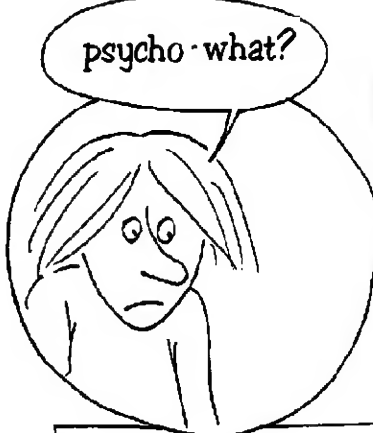
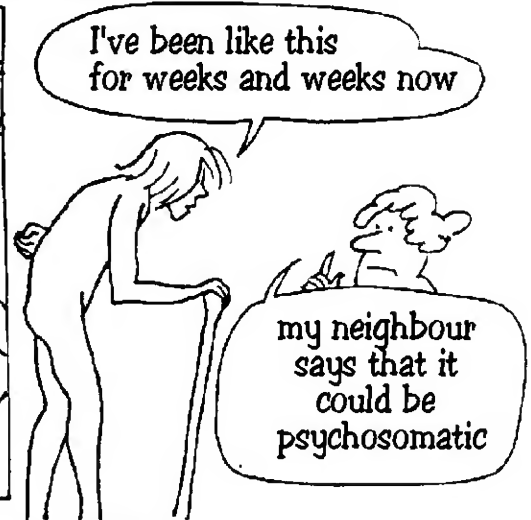
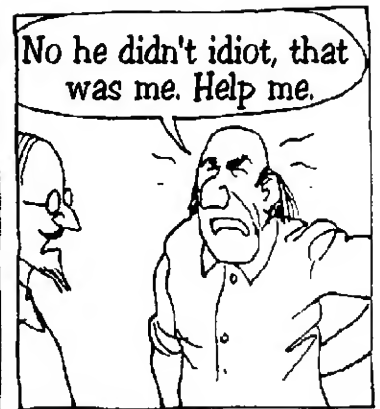
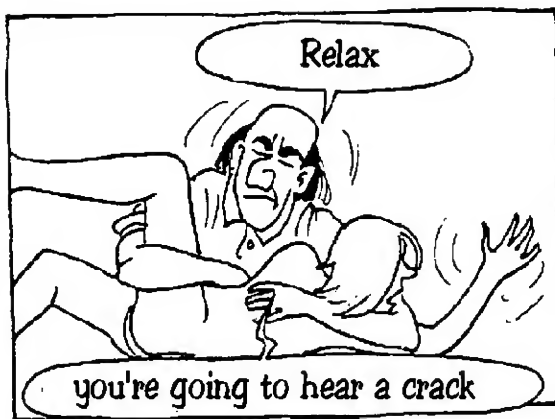
In the case of a **SPRAINED NECK** the cervical column can be immobilised with the help of a neck brace to suppress contraction and movement. But as soon as the pain has passed the neck needs to be exercised to avoid muscular atrophy, which happens **VERY QUICKLY**. After 15 days of unemployment the muscles will have the greatest difficulty holding the head upright.

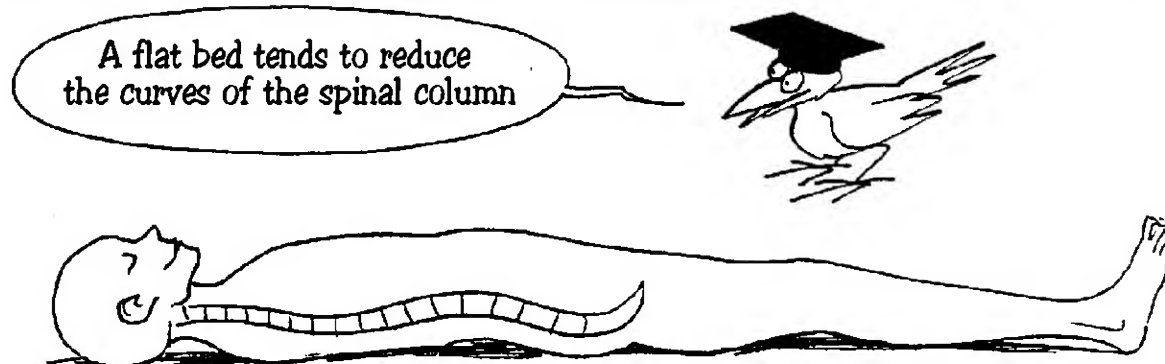
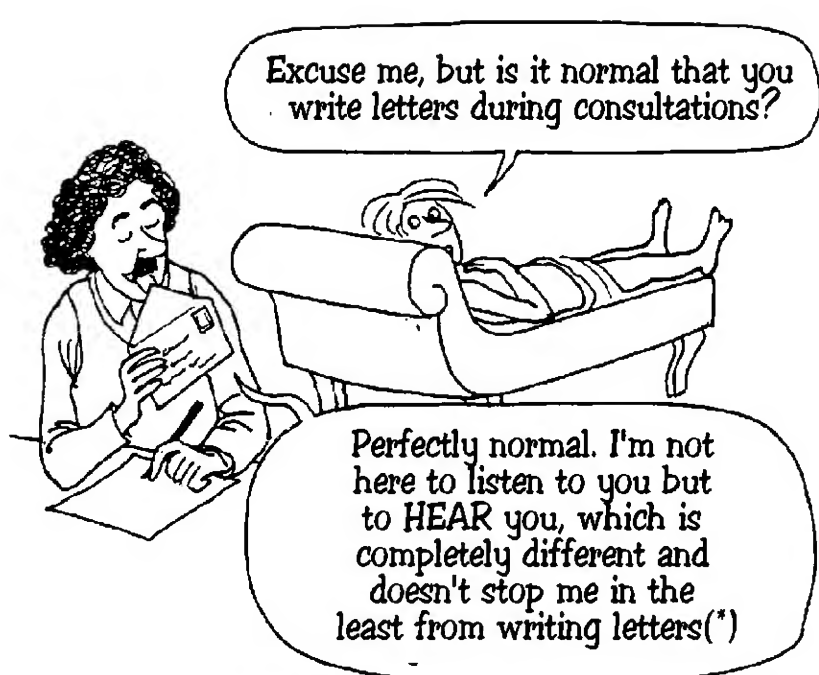


ACUTE LUMBAGO









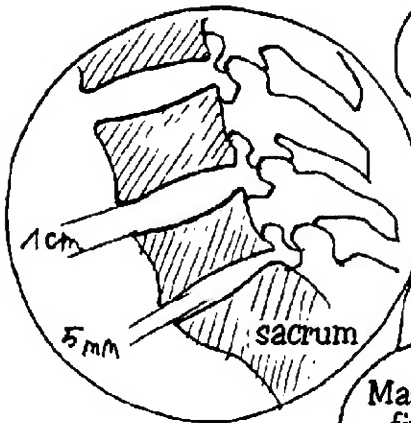
CHRONIC LUMBAGO

Hey, your prototype doesn't seem to be working very well. We need a precise diagnostic.

Let us look at his vertebra with a SPONDYLOSCOPE (*)

Oh dear!

It looks like there is an compression of two vertebrae in the LUMBO-SACRAL region, the junction between the sacrum and the first lumbar vertebra



So the disc wasn't such a good idea after all?

Master, we need to find out exactly what is happening

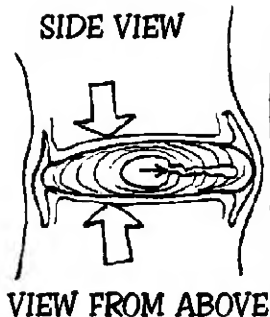
In fact, when our man lifted his megapumpkin his effort created enormous pressure and compression on the lumbosacral hinge, resulting in the expulsion of the nucleus to the rear.



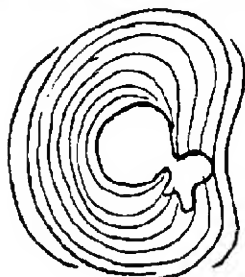
PFFFT !

Similar to the way we shoot a cherry stone through our fingers

(*) from SPONDYLOS, vertebra, and SCOPEIN, see

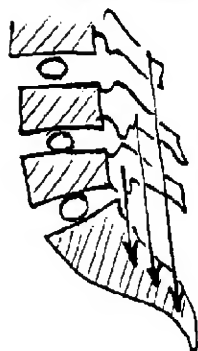


In principle this displacement should be blocked by the fibrous envelope enclosing the nucleus. This is made up of concentric nets with an extremely small mesh. But violent effort can cause the irreversible rupture of these envelopes and allows the gelatinous, but fluid, nucleus to seep into the fissures.

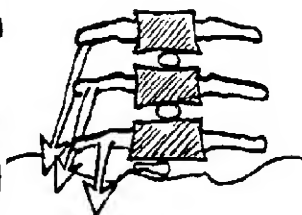
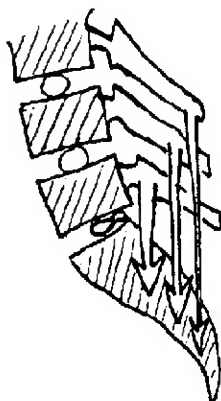


The fissurisation can progressively worsen as a result of repeated efforts but pain is only felt when the nucleus compresses the posterior ligament which is highly innervated.

ANTALGIC ATTITUDE

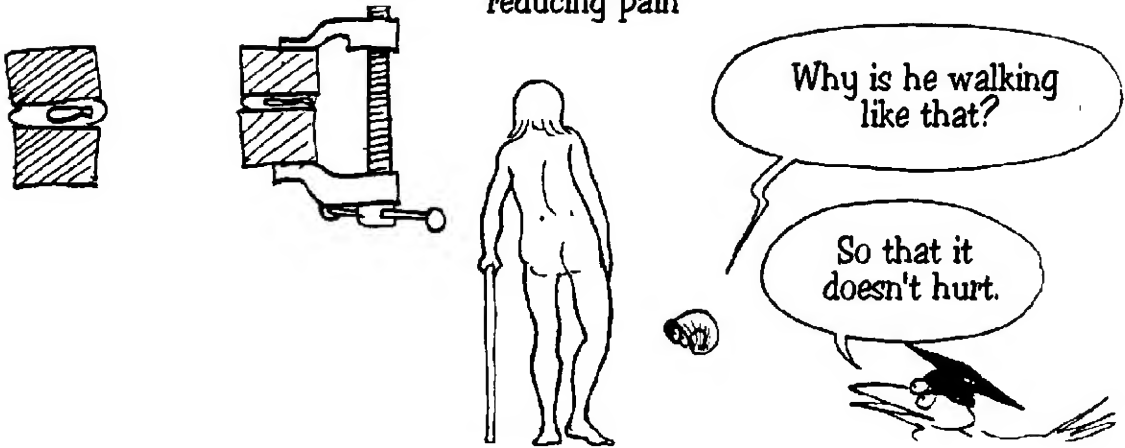


When the vertebral nucleii are in their normal position, the torso juts out a little towards the front so standing requires that the posterior spinal muscles be contracted slightly to counteract it. However when there is a lesion and displacement of a nucleus (as here on the lumbar-sacral hinge) the torso juts out further, so that standing still requires a greatly increased contraction of these muscles. As the migration of the nucleus' jelly is never axial, the lateral muscles, which act as 'guy ropes' also tense up.

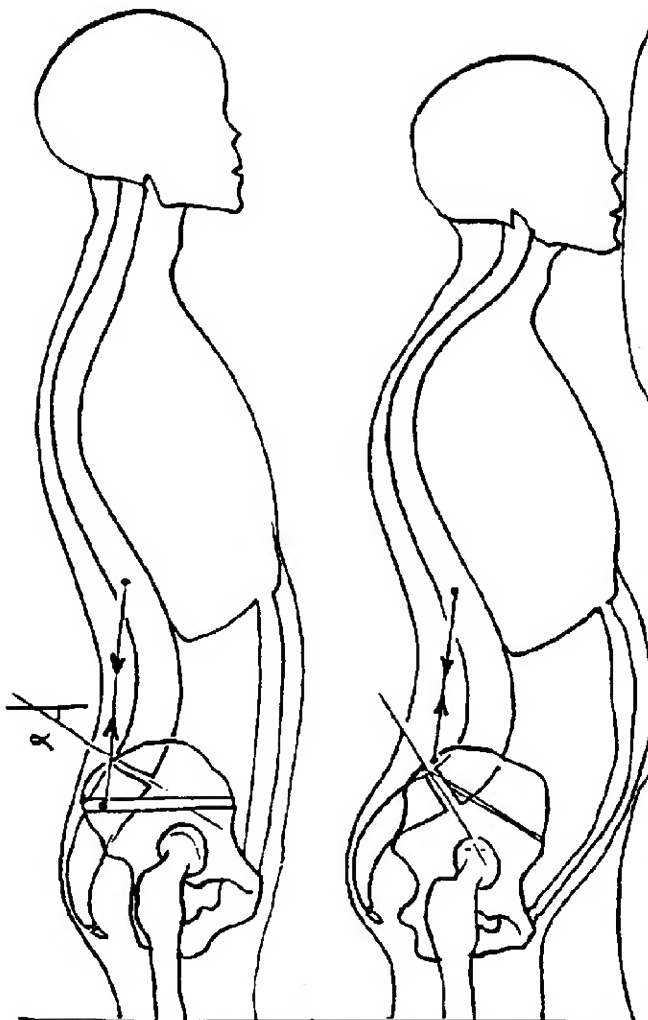


The Management.

This muscular tension is a REFLEX ACTION, aimed at reducing pain



LUMBAR DEFORMATION



A violent contraction of the muscles holding the spinal column and the bones of the pelvis region will cause both the pelvis and the SACRAL PLATEAU, the surface on which the entire column rests, to ROTATE. This causes an imbalance that will eventually spread to the entire spine.



The angle of the disc provokes contraction which unbalances the spinal column and causes a secondary problem. It's all wonderfully AUTO-UNSTABLE.

The sacral plateau is normally inclined at 30 to 45° from the horizontal (α angle)

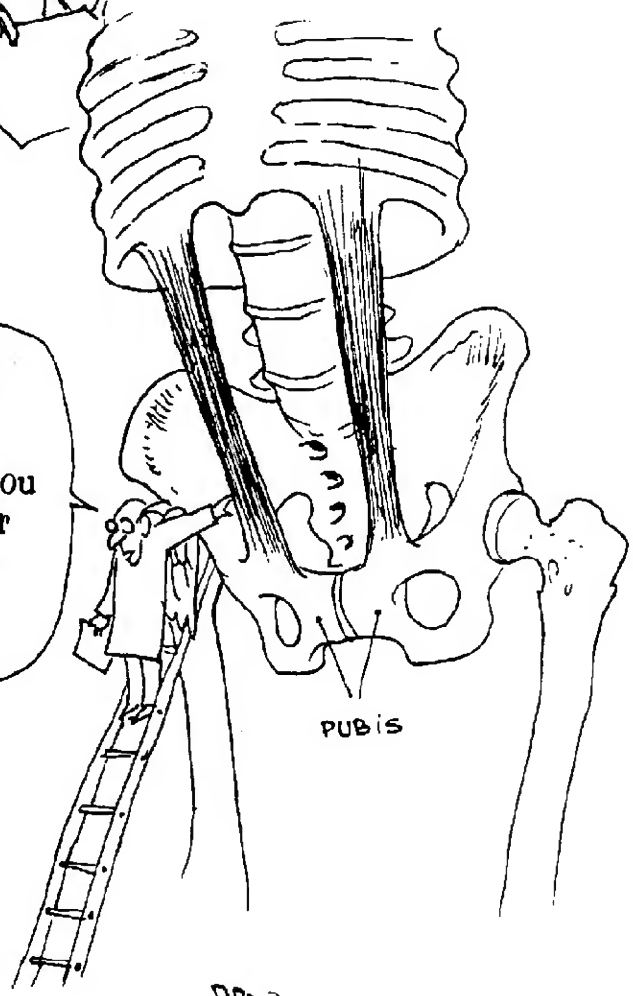
Auto unstable! Did you hear? **AUTO-UNSTABLE!**
Well done you!

But this prototype was designed to collect apples not mega-pumpkins

Right, here's the idea: between the rib cage and the anterior arcade of the pelvis, the **PUBIS**, there are powerful muscles, **ABDOMINALS**. If you make them work they will get firmer and pull continuously on the pubis, and so counter the catastrophic rotation of the pelvis.

Right, lets get to work on these abdominals.

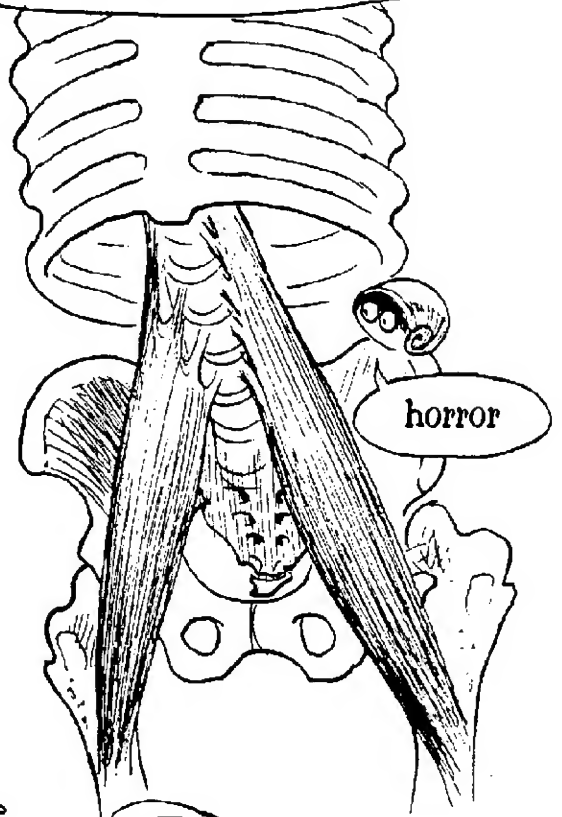
Let's see ...
 $\sin \left\{ \frac{1+x^2}{\sqrt{1+x}} + \log x \right\}^{\frac{1}{2}}$
that should do it



Hmm, that hurts quite a lot and I can't say I feel any better for it, on the contrary

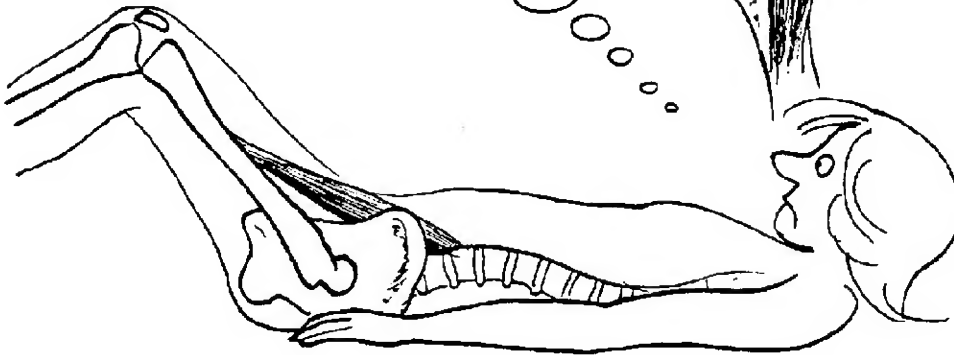


Of course! When you raise your legs you are putting another muscle to work, the PSOAS which is attached to the lumbar vertebrae



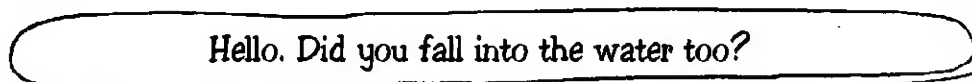
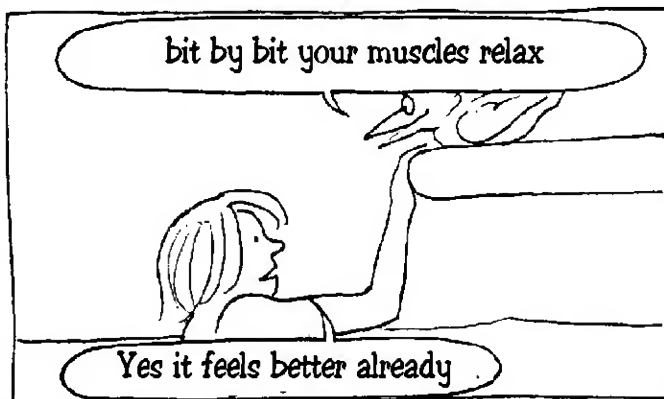
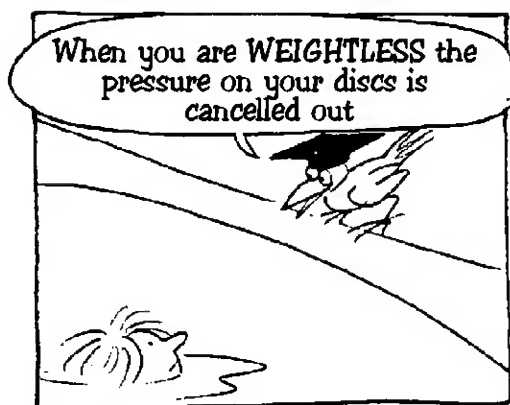
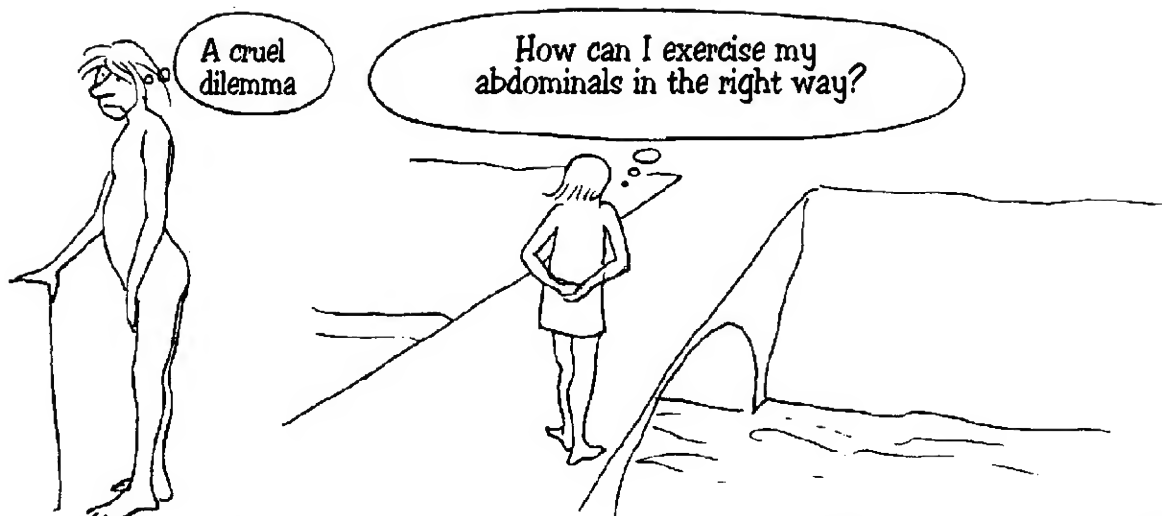
horror


Which means that when I make these movements I'm working my abdos hard but at the same time I'm curving my spine. Terrible...




While in that position you're easing the pain, but you aren't doing anything to remove the CAUSE of it.








In a situation of **WEIGHTLESSNESS** we can incite the matter making up the nucleus to reintegrate its usual position. You just have to move your backbone gently in all directions which will create a **SUCTION** effect



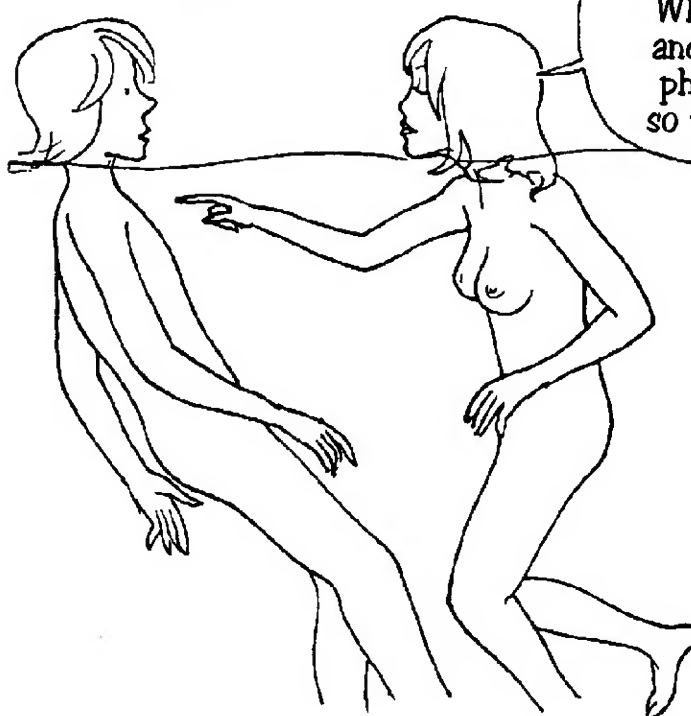
Here, for example, I'm making a **TWISTING** movement, very slowly and without **EVER FORCING**. It must remain **PAINLESS**



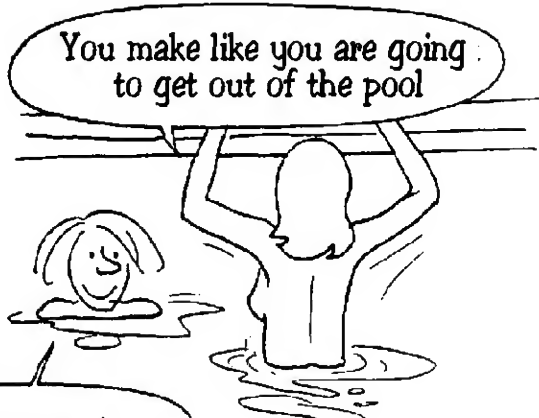
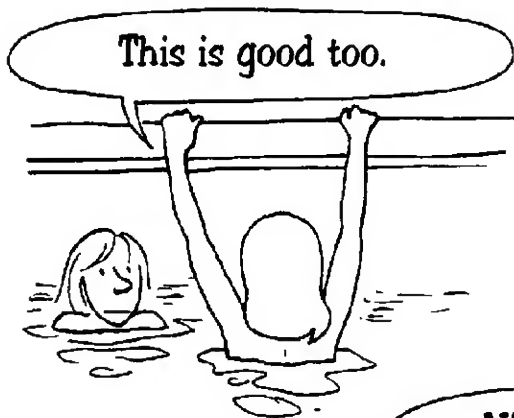
Here, by holding on to a ladder, I can stretch out and bring back my legs

AQUAGYM

But how is it different to the same movements are done on the surface?

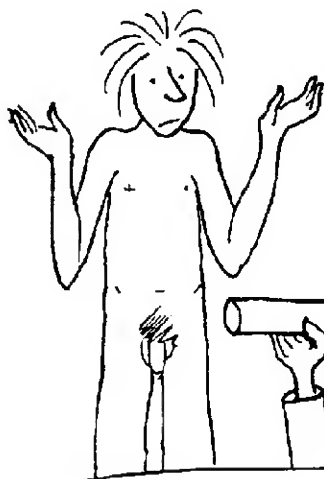


On the surface, under the effect of **WEIGHT**, the disks are compressed and the **ANTALGIC CONTRACTION** phenomenon appears immediately, so these gymnastics have no benefit.

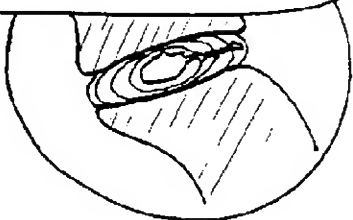


Nice movement

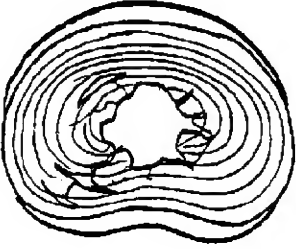
At the end of the 6th day the man felt a lot better and rested.



Absolutely astonishing. In effect, the nucleus has indeed returned to its position. The column has its normal curve once more. The pelvis has straightened up, or enough anyway. There remains a slight residual disc compression.

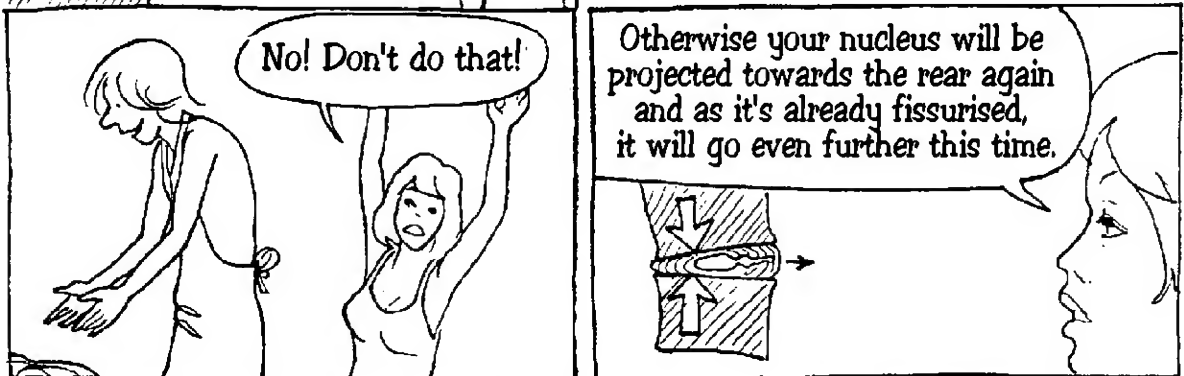
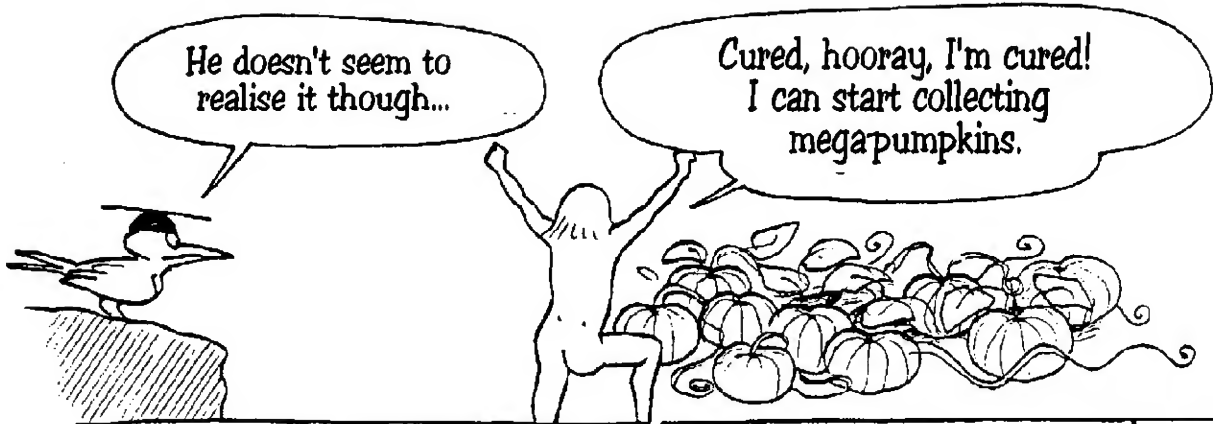


Yes but the fissurisation remains and the nucleus will slip out as soon as it gets the chance.

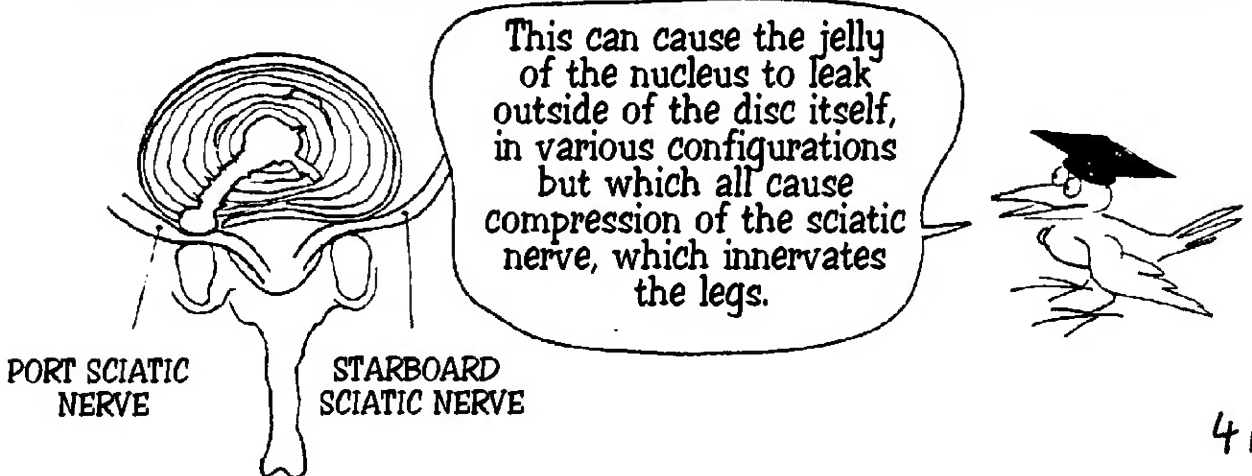
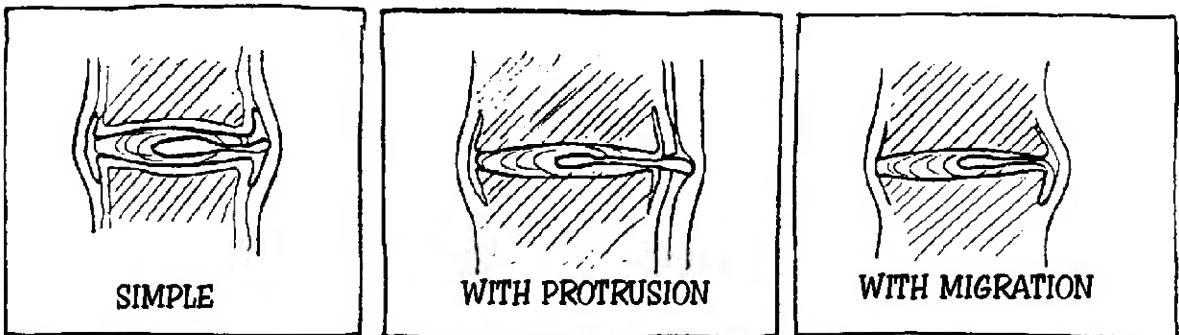


Man must understand that his disks do NOT HEAL. Fibre fractures are never repaired and come the next megapumpkin...

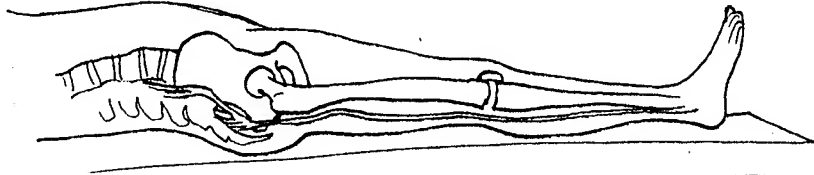




SLIPPED DISCS



If the slipped disc is at lumbar level it can be seen by provoking the flexion of the lower member, with knees straight, which will pull the **SCIATIC NERVE** which runs below the tibia and along the back of the leg from the thigh to the calf.



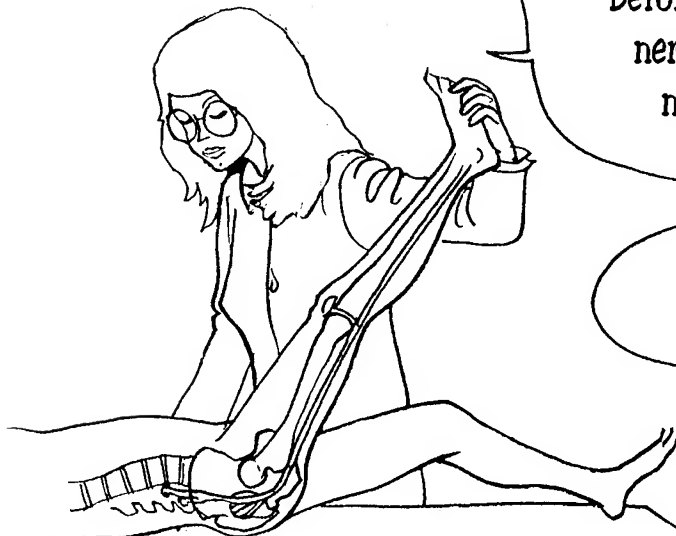
Don't be silly, it's normal. From 90° onwards it always hurts a bit because the nerve is being stretched to its maximum natural limit, the same for the muscle under the thigh.

OUCH!



If you had a slipped disc affecting your sciatic nerve you would have shouted before because the compression of your nerves would have stopped it sliding naturally in the vertebral channel.

This is called the **LASSEGUE SIGN**



What sliding of the nerve?
I thought a slipped disc
compressed the marrow.

Not in this area, the marrow, the cord,
stops further up. At this level there
is only a bunch of nerves called the
CAUDA EQUINA because it looks like a
horse's tail



Unless there is the presences of serious sciatica or worrying symptoms of paralysis, in which case a specialist should be consulted **URGENTLY**, it is worth trying a dozen or so sessions of gymnastics in a weightless situation to see if the situation can be put back to normal. Of course these exercises should not be begun until the pain has abated sufficiently.

The Management.

Get into the water **SLOWLY**

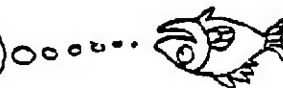
NO!



No, not the breast stroke, it curves the
base of the back



if you swim, swim on your back





in warm water wait at least quarter of an hour for your muscles to relax properly. Do the gym gently without ever forcing, and get out gently afterwards.

Why did you pay so much attention to the lumbar region?



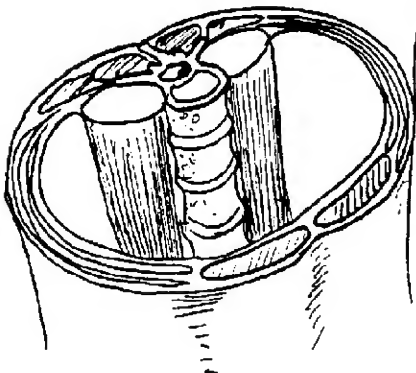
Because it is **THE** fragile part of the skeleton, where 80% of the trouble comes from.

What are you doing?

Well now that my backbone is looking more or less alright, I've decided to keep it that way by wearing this corset.



THE MUSCULAR CORSET



If you do you'll demuscle yourself and become dependent on that silly belt. Why not use the **NATURAL CORSET** that nature gave you?



The main effect of pool gymnastics, because done in a **WEIGHTLESS** situation, was to allow vertebral **MOVEMENT**, a basic condition for the discs nucleii to reintegrate their positions. Now you need to **CONSOLIDATE** this precarious structure by strengthening your **MUSCULAR CORSET**

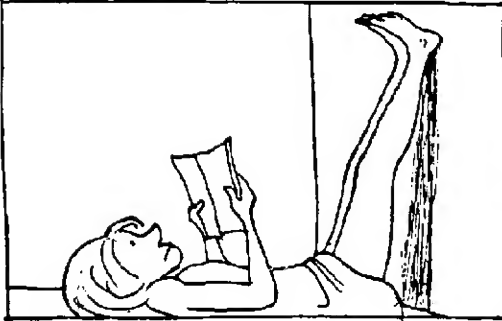
You mean I'll have to go back into blinking swimming pools until I grow scales?

At the point you are at, and given that your spinal column has refound mobility without pain, I don't think that that will be necessary

In the swimming pool the water allowed **EFFORTLESS MOVEMENT**. Here we're going to opt for **EFFORT WITHOUT MOVEMENT** by holding a position that won't cause trouble for the vertebrae.

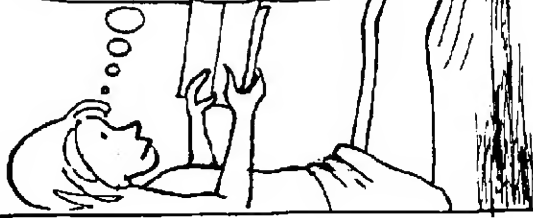
The human muscular corset is made up of layers of muscles whose fibres lie in different directions. Each muscle group has a corresponding gym exercise.

Such as this. With feet resting on the wall the lumbar region is resting flat against the floor.



Lift the heels off for a few seconds and then put them back again and so on.

This must have been invented by a Mexican during his siesta



To work the muscles parallel to the spinal column, over the whole length (spinal muscles), lay flat on the floor with a pillow under the stomach so that the spine remains straight (*)



The other movements require an accessory

What?

You're sitting on it.



While holding the armrests try to turn your body but stop it at the same time by pressing with your bottom



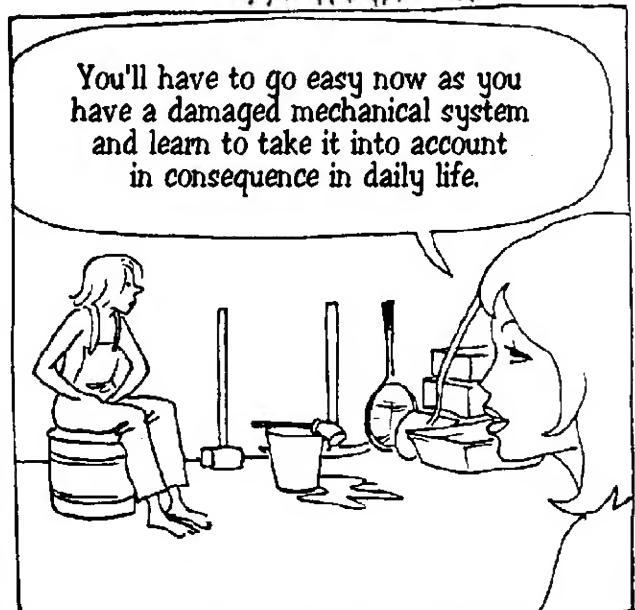
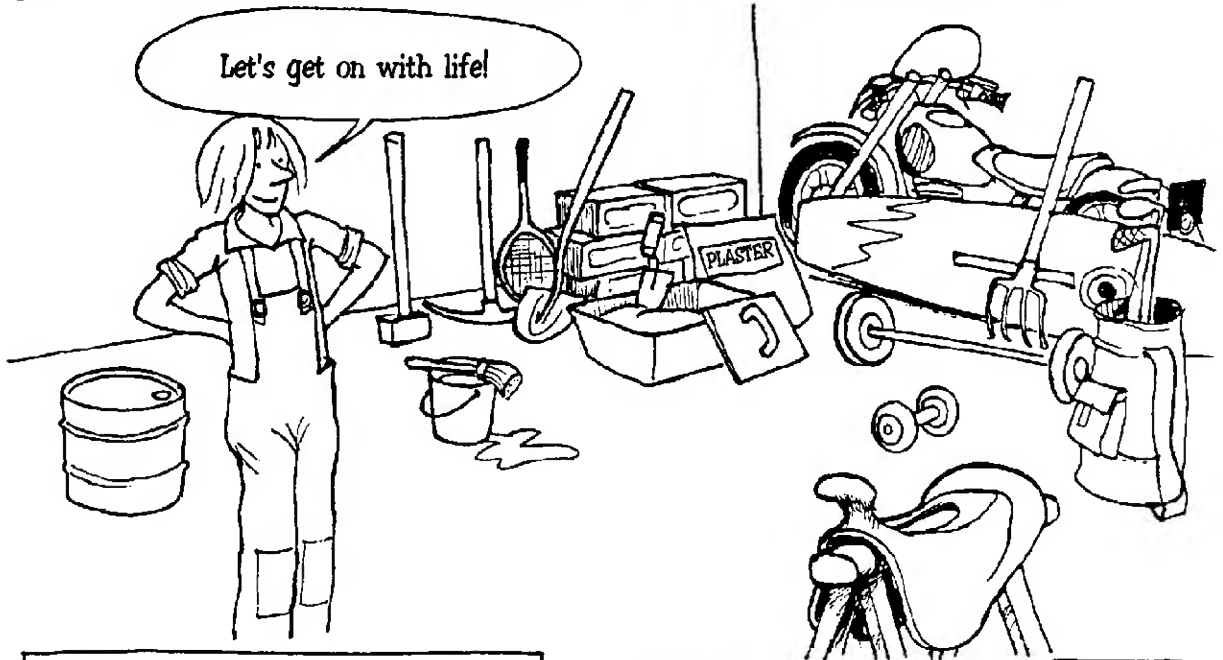
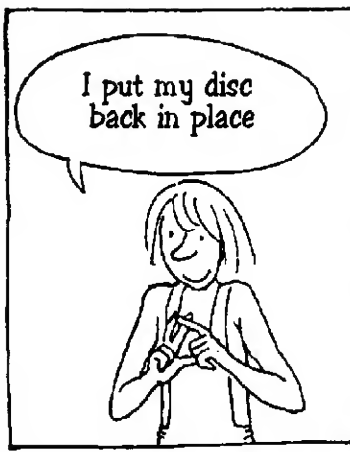
The last movement entails sitting on the edge of the armchair with feet flat on the ground. Let the torso lean back a bit but block it before it touches the chair back. Then breathe out while pulling the stomach in.



(*)

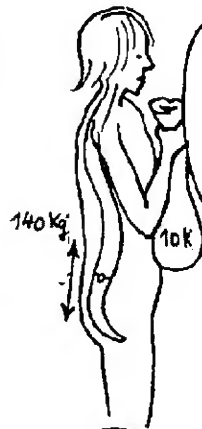
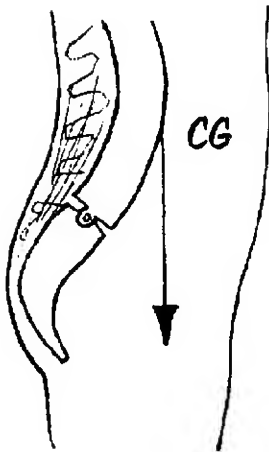
There is a much more natural way of working the abdominals but decency precludes us from presenting it here.

A few weeks later...

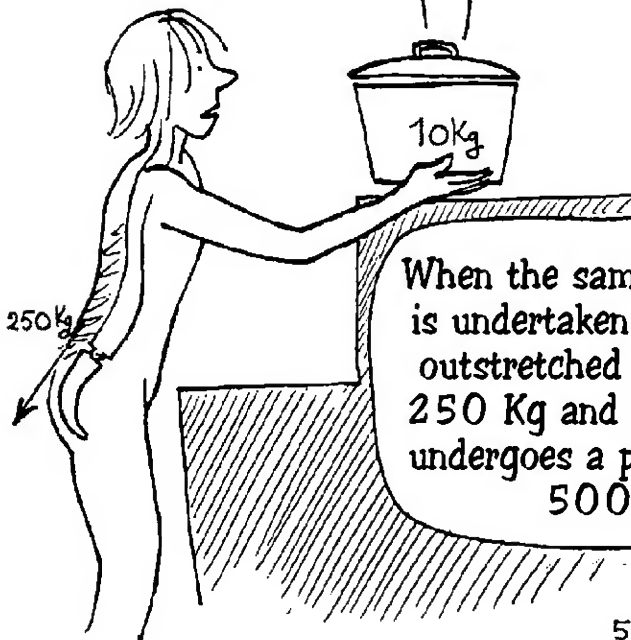


PREVENTING LUMBAGO

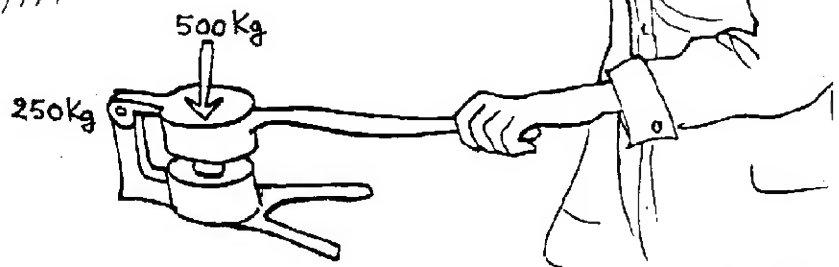
In a normal position the centre of gravity of the group head, torso and arms is forward of the lumbar-sacral hinge.



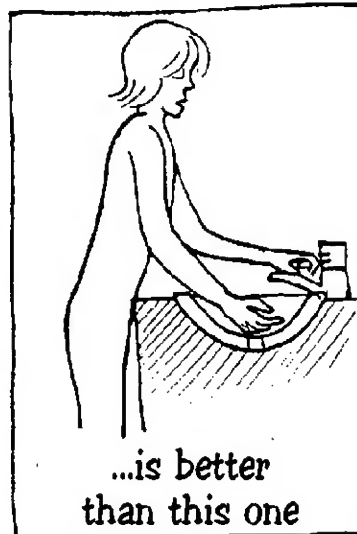
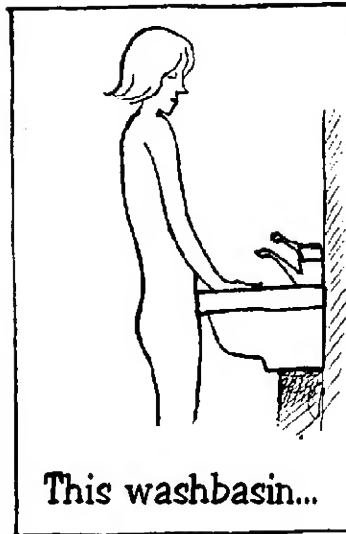
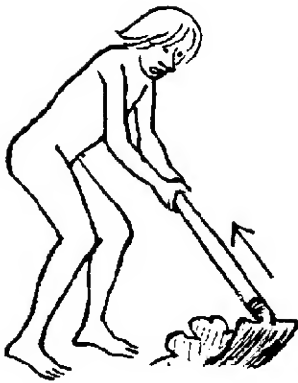
When lifting something weighing 10 Kg, held against the torso, the spinal muscles running the length of the spine must develop 140Kg.



When the same operation is undertaken with arms outstretched it requires 250 Kg and the nucleus undergoes a pressure of... 500 Kg



So some movements are FORBIDDEN



Loads need to be lifted by leg force,
not with the vertebrae.



High heels increase
the curve of the spine

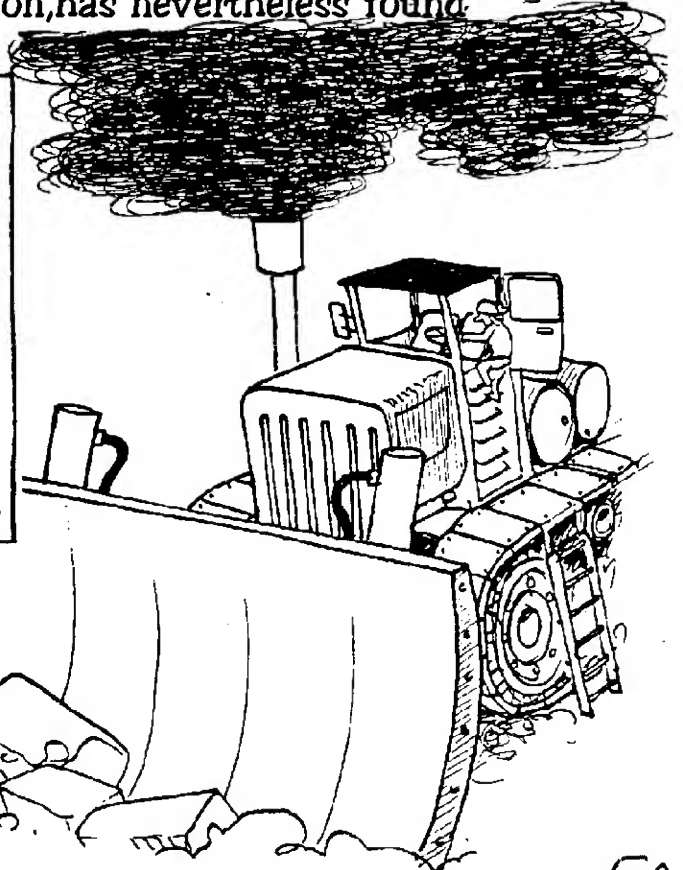
Hmm...

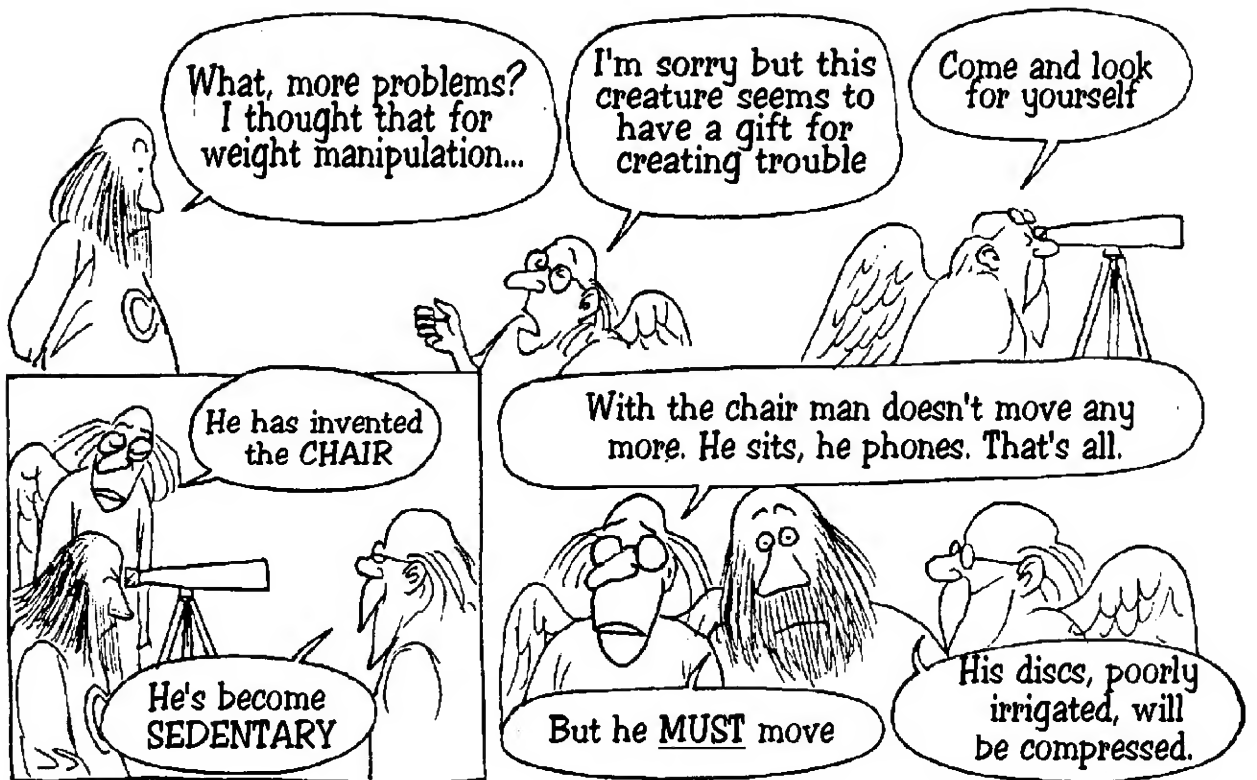
OK, there are a few structural weaknesses I admit but remember, the basic problem is that man is trying to do things he wasn't designed for.

Who would have thought that this imbecile would start to build cyclopean temples made of enormous blocks just so that he has somewhere that treats his vertebral problems.

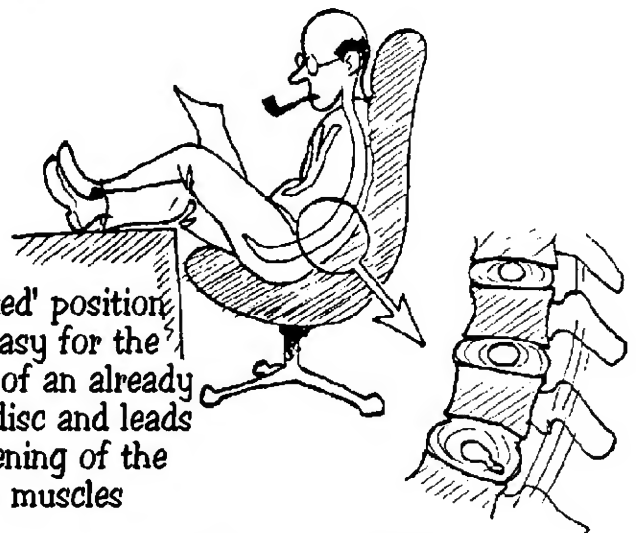
I'll give you that...

So, because of his obstinate desire to lift heavy weights at all costs, mankind, with time and imagination, has nevertheless found ways of limiting the damage.

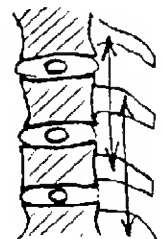
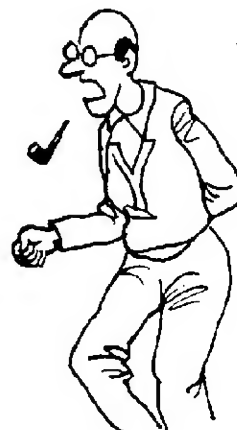




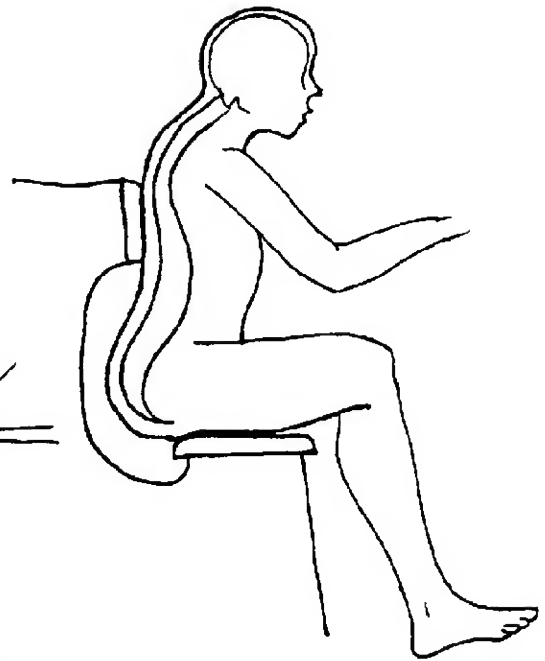
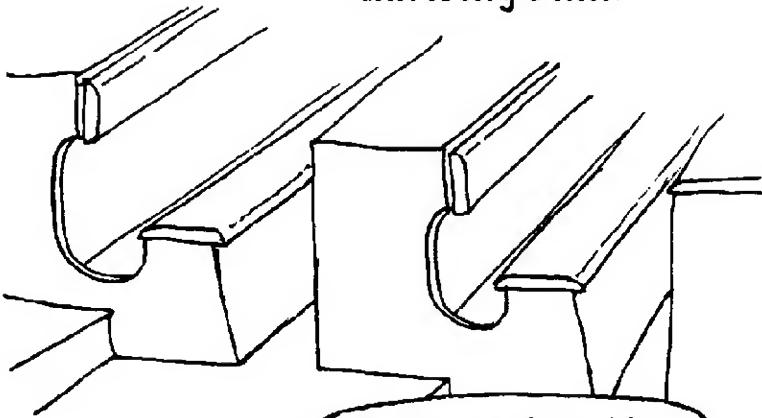
This 'relaxed' position
makes it easy for the
migration of an already
damaged disc and leads
to a slackening of the
abdominal muscles



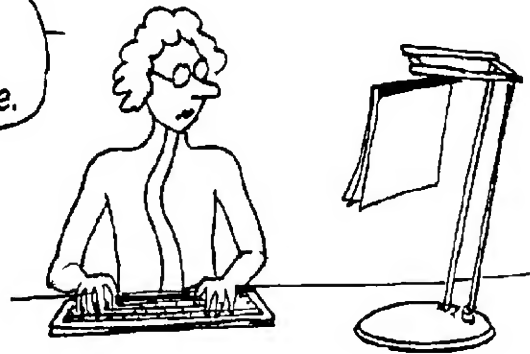
Antalgia



Here is a fine example of
a vertebra-breaker, the
university bench

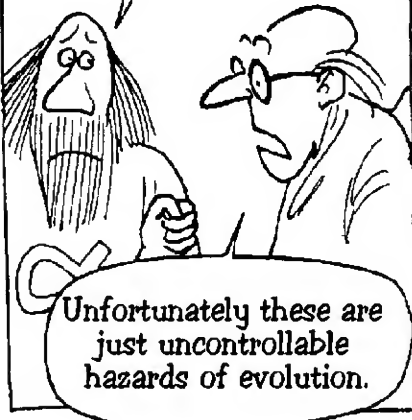


Another redoubtable
scoliogenic version,
the seat with side table.



And here, a method for the rapid destruction
of the cervical vertebrae.

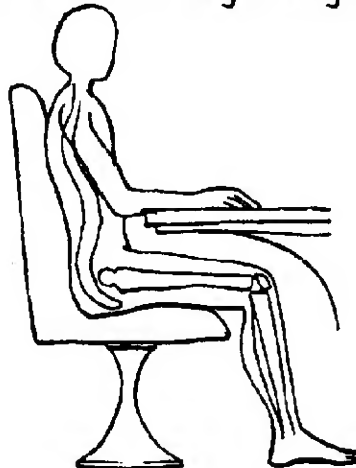
Do they really have to sit
down? Couldn't they...well
...I don't know...hang
from coat hangers for
instance?

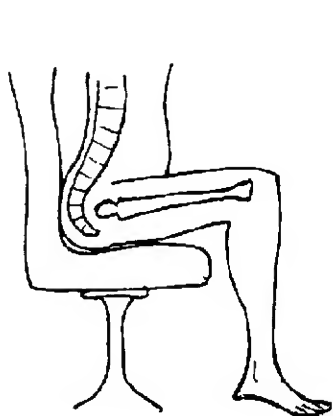


Unfortunately these are
just uncontrollable
hazards of evolution.

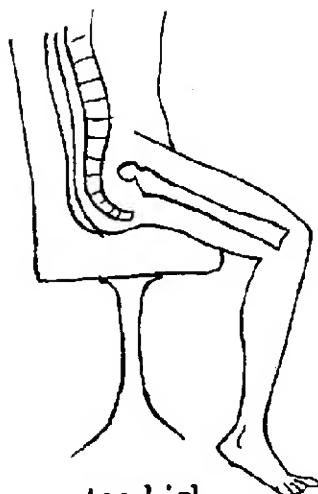
Being seated correctly needs:

- Support for the lumbar rachis
- Femurs horizontal.
- Feet flat on the floor
- Elbows at the right height.





Seat too low



too high

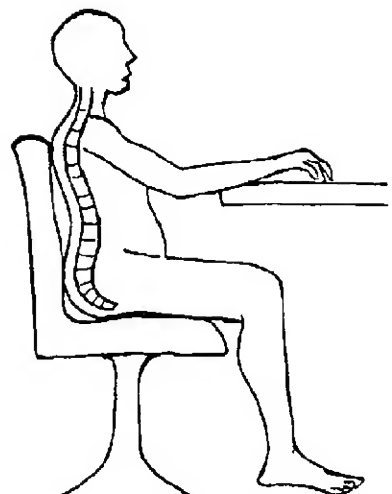


Table too high

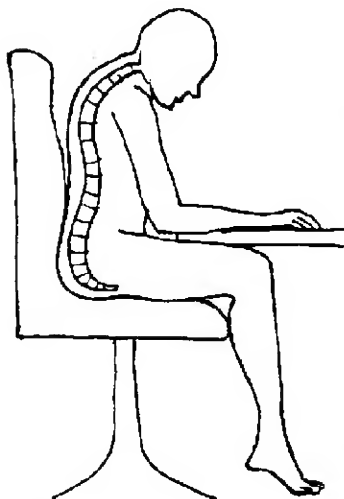
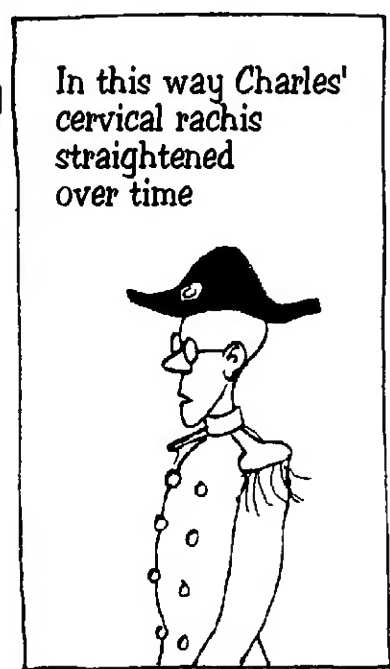
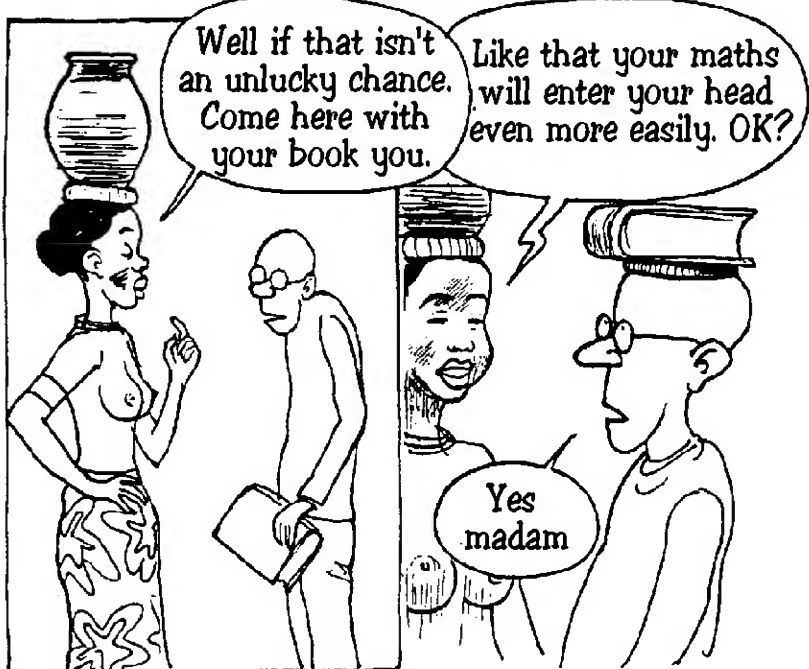
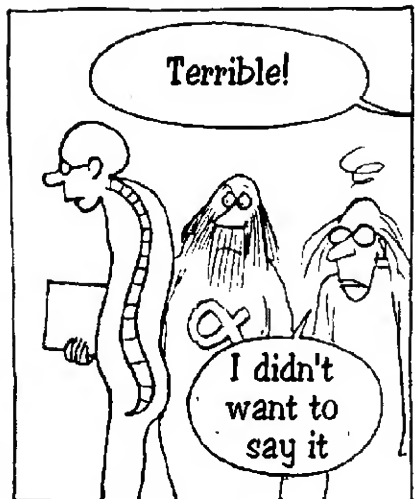
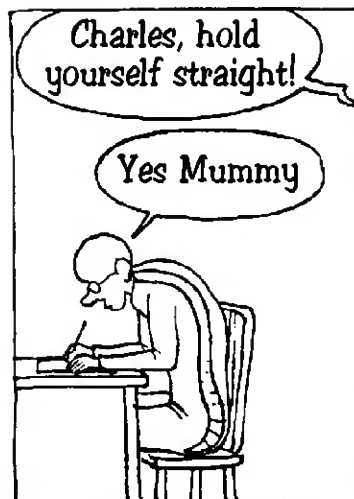
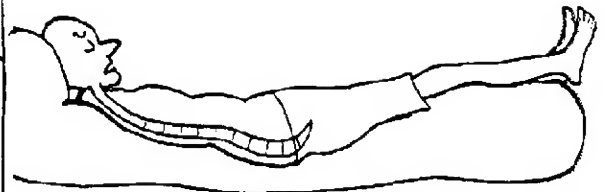
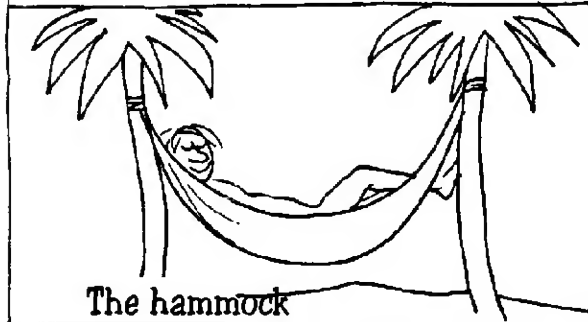


Table too low



The sloppy and falsely comfortable position already mentioned on page 51 has its equivalent lying down



The too soft bed

Nothing is better than a HARD bed.



My hotel bed is too soft, I prefer to sleep on the floor

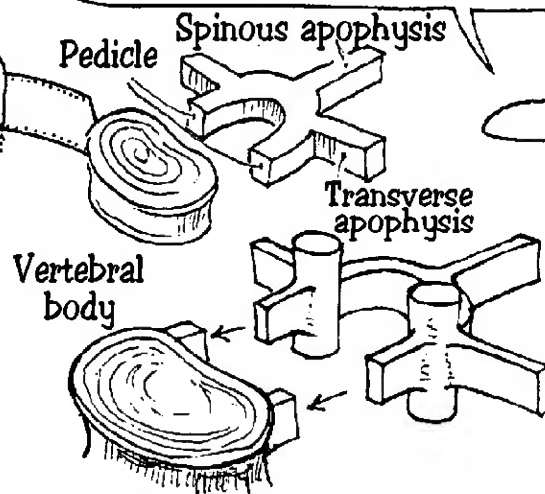
MALFORMATIONS

So how are you getting on with the new series. Any better than the last?

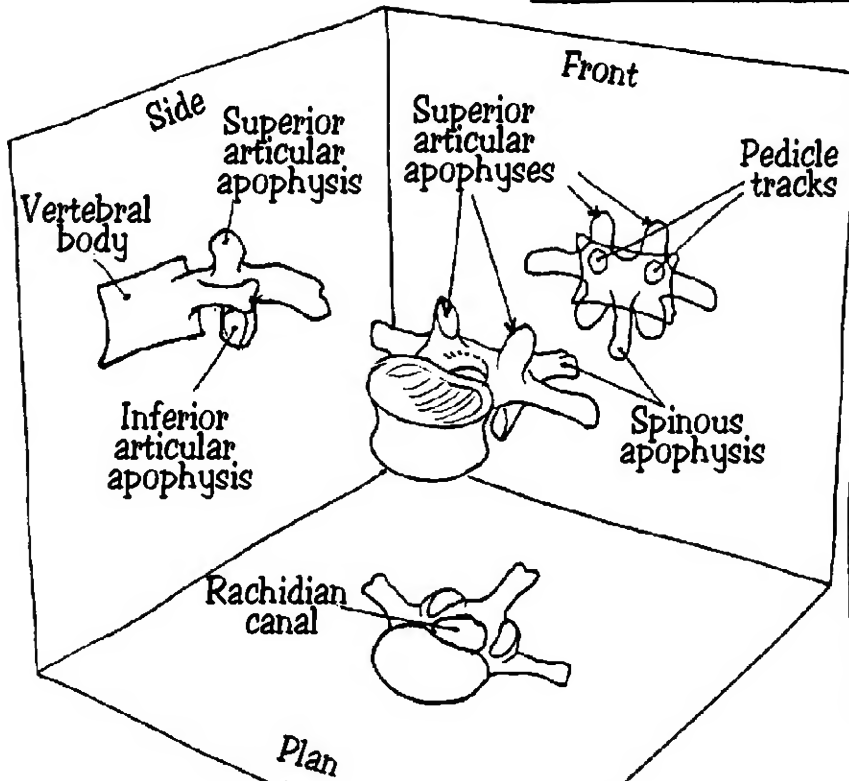


Whoah, don't mention it, we've had loads of false starts.

You remember the general principle of the vertebra. A solid, cylindrical body, a medullar canal and outgrowths called apophyses which allows the articulation of vertebrae or are used to attach muscles

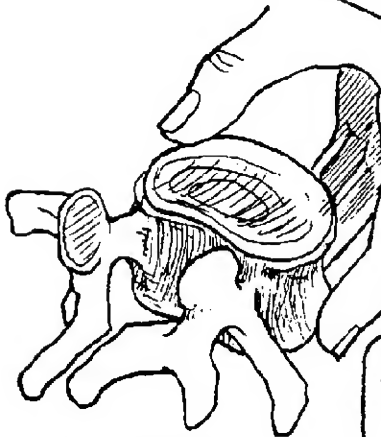


LUMBAR VERTEBRAE

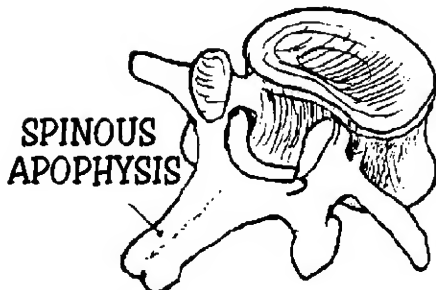


This is the general schema. On a foetal level the vertebrae are constructed according to a precise plan, but sometimes things go wrong

Fifteen per cent of humans are born with an absence of welding of their vertebral arcs, which should have become spinous apophyses. This is called **SPINA BIFIDA**



SPINA BIFIDA



NORMAL VERTEBRA

That's a pain

yes...but people don't suffer with it

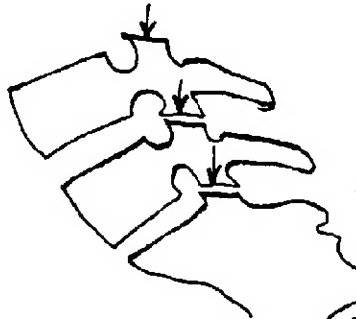


What is a lot more worrying is that the vertebrae are separated by discs but are also articulated on four apophyses which have small articular cushions called **MENISCI** between them. These are like small flat bags and are filled with an oily substance called **SYNOVIA**.

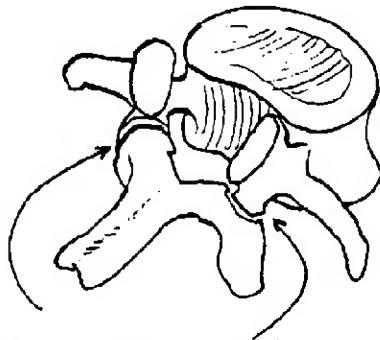
Articular apophyses



meniscus



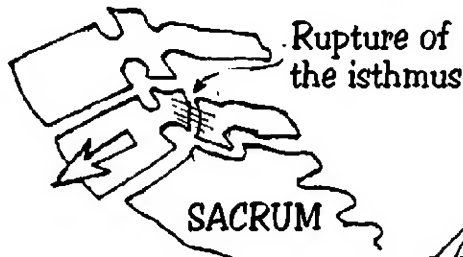
At the lumbar level these apophyses behave like locks, each vertebra opposing the movement of the one above



Nonossified isthmus

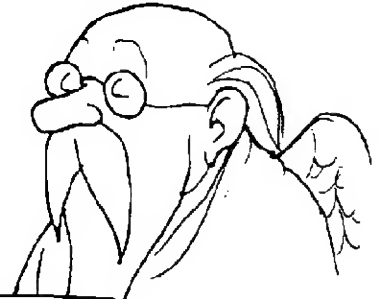


But 15% of our subjects are born with bony arcs, called isthmuses, that haven't ossified. So the whole thing only holds up with fibres that are more or less strong according to the case



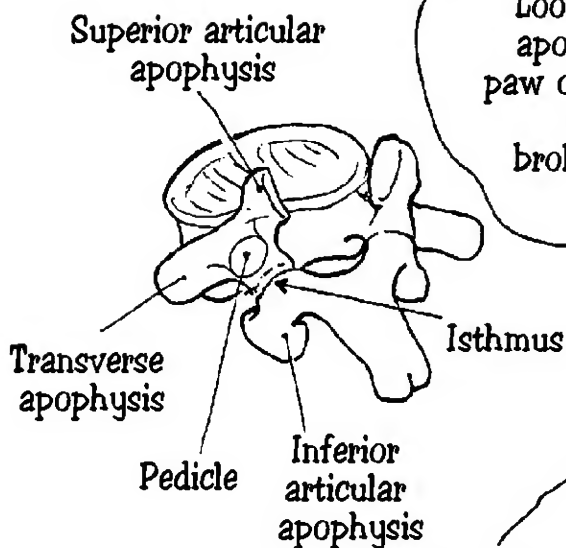
Rupture of the isthmus

SACRUM



Yes I see. Here the first lumbar vertebra, whose isthmuses haven't ossified, has to support the weight of the spinal column by blocking itself at S on the sacrum. Unfortunately these two parts aren't solidly fixed to each other. The progressive slipping of a vertebra is always possible (*)

(*) In Greek, Spondylos means vertebra, and Olisthesis means sliding, so the term for a slipped vertebra is **SPONDYLOLISTHESIS**



Looked at in a certain way the ensemble of apophyses look a bit like the ear, nose and paw of a small dog, with the pedoncle forming its "eye". If the little dog's "neck" is broken we know that this corresponds to a malformed isthmus.

A brilliant diagnosis, so what does one do in such cases?

Nothing, or almost nothing. Fortunately most people never notice, for others it can reveal itself with age or after a violent shock

It can be diagnosed early in children, from the age of 10 or 12. We advise them not to become removal men or weightlifters

So it makes an extra vertebra...

That fellow is standing in a peculiar way don't you think?

Ah, that's something else

SCOLIOSIS

Goodness!

Sometimes, for an unexplained reason, one of the vertebrae starts to **TURN**, which completely unbalances the spinal column. The subject on page 47 showing the symptoms of this rotation. We call it a **GIBBOSITY**

Ah, here's the boss

Who are all these people?

The vertebrous

They are all suffering from various problems due to vertebral malfunctioning

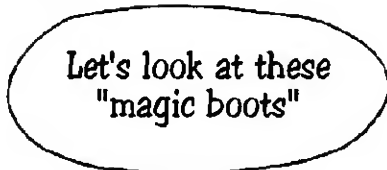
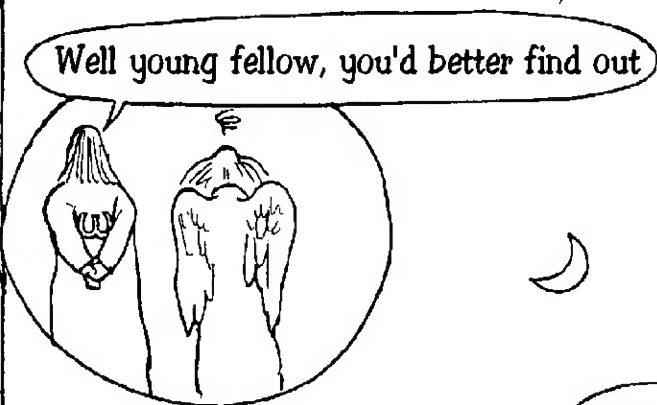
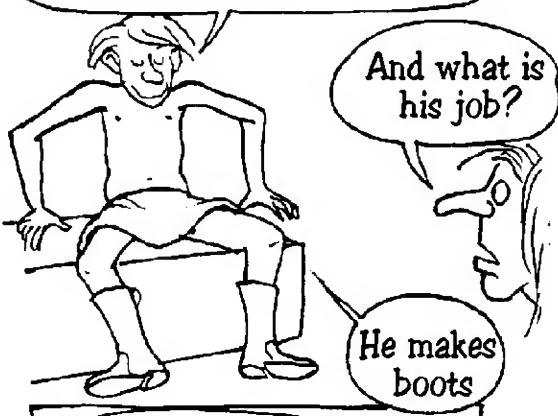
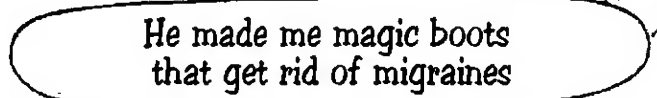
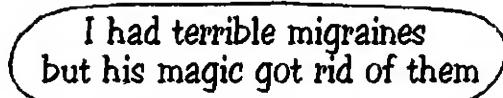
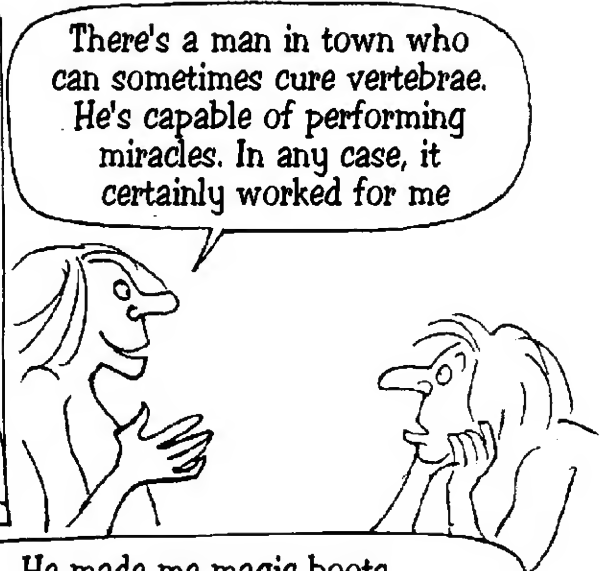
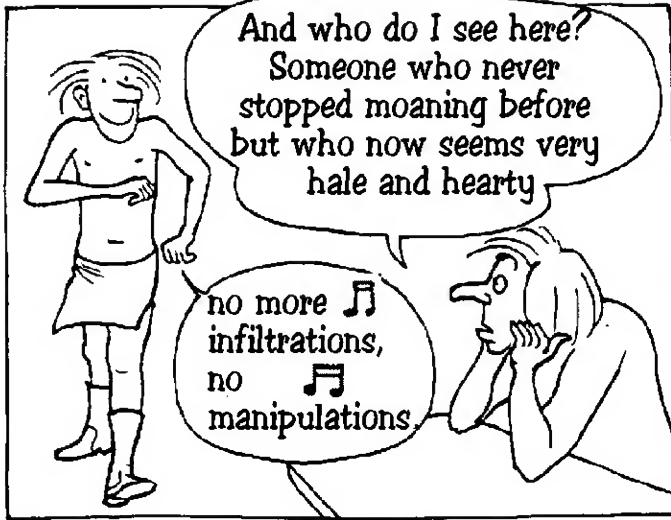
Oooh!

ayee!

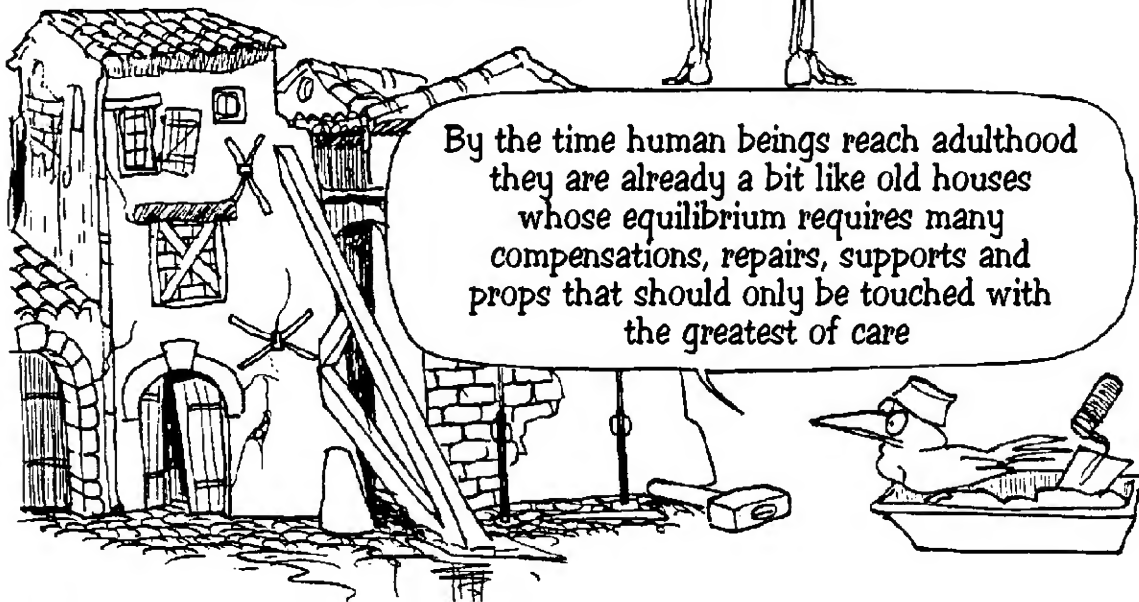
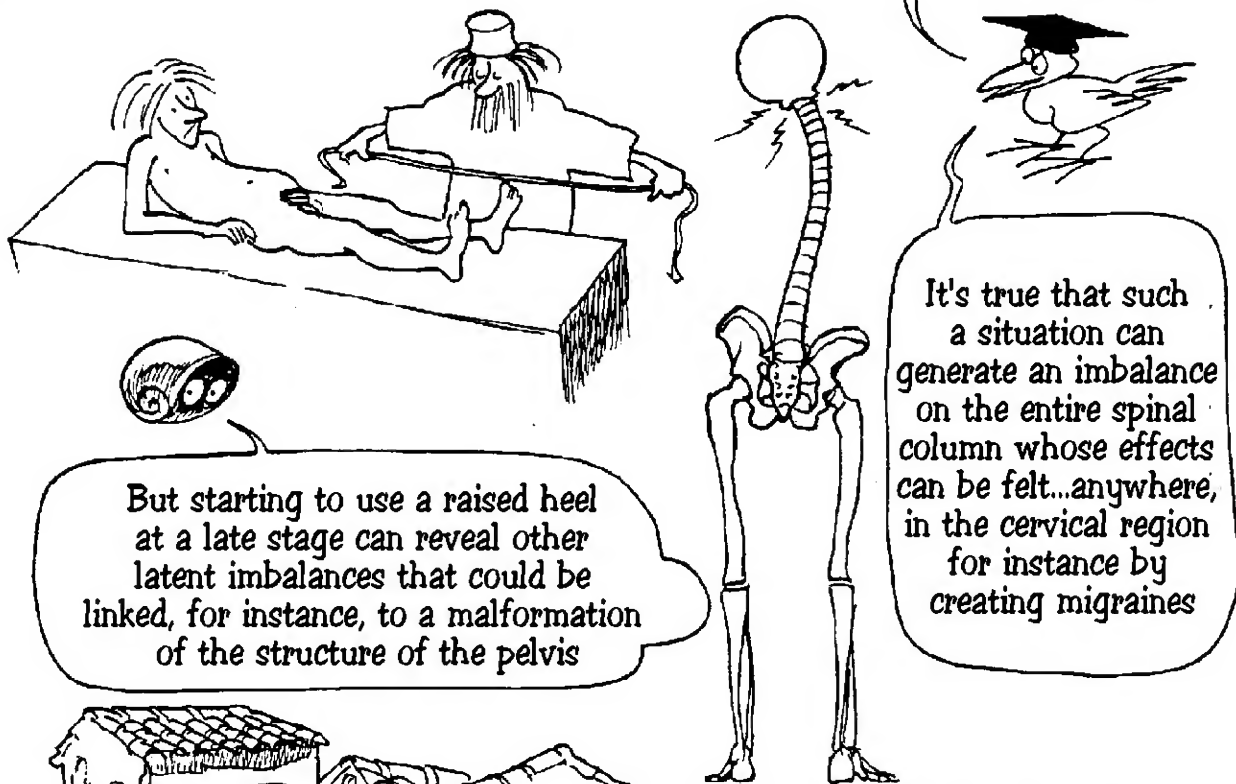
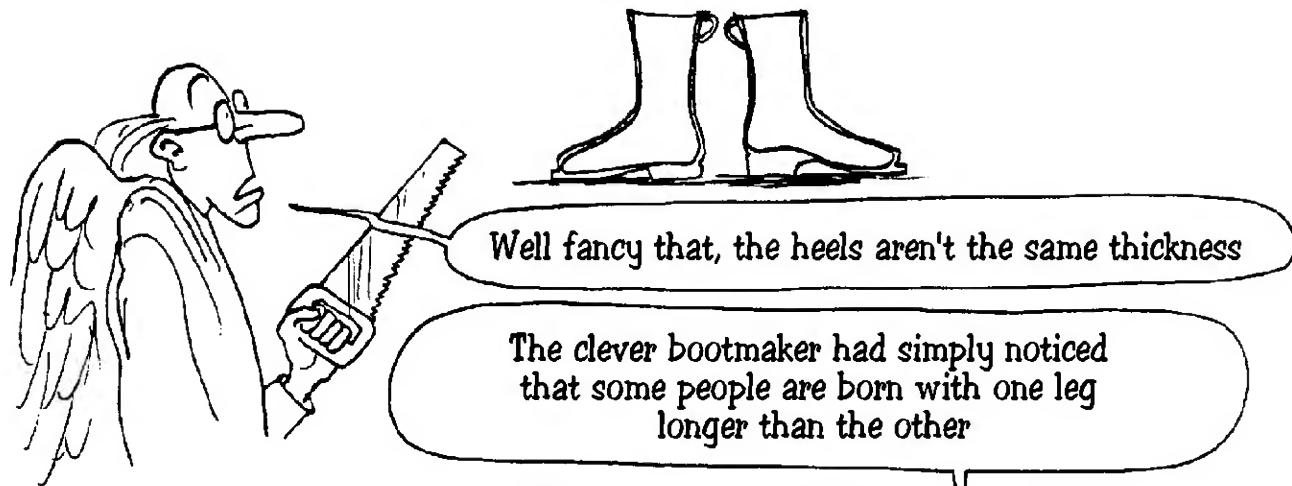
Oh the pain in my neck

This one has nerve inflammation which causes terrible headaches

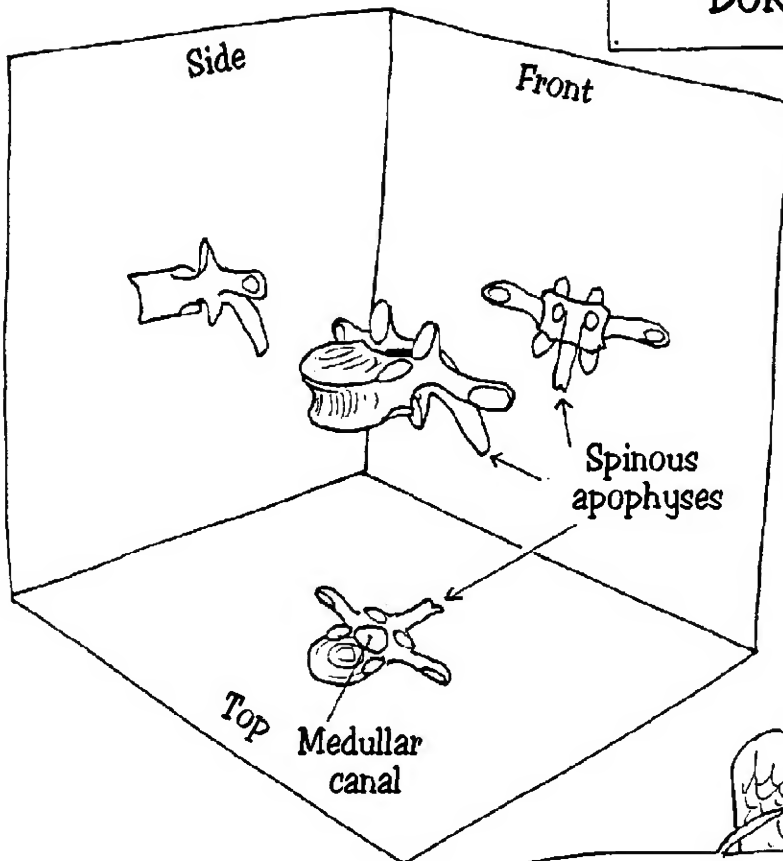
And the planet was filled with the sound of wailing and lamentations from the afflicted bipeds



After some effort



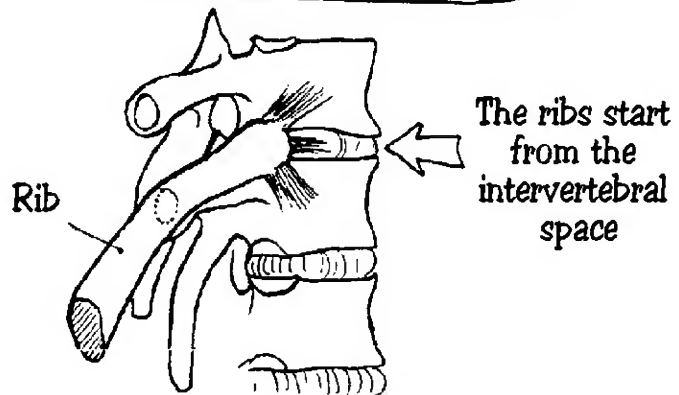
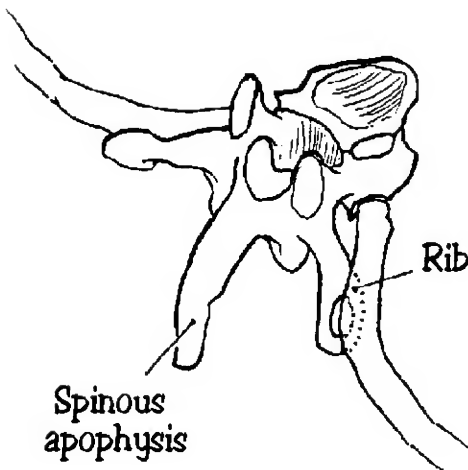
DORSAL VERTEBRA

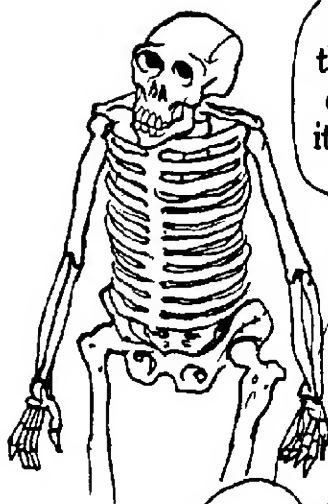


The dorsal vertebra is definitely a success though. There is almost no return. It is held solidly to the body by the ribs

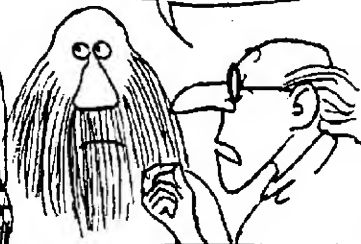


Well then, why didn't you use just this type of vertebra?

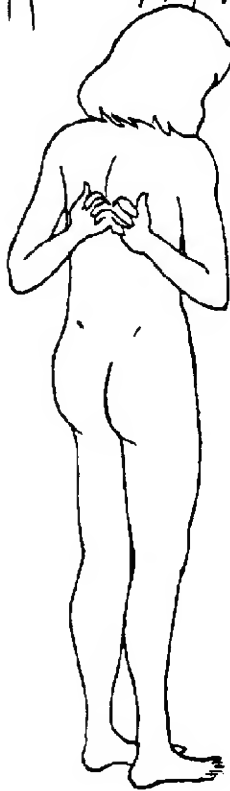




We tried, but with that the animal wasn't even capable of tying its shoelaces. It couldn't turn its head either



The spinous apophyses are frequently twisted naturally and when a sinuosity is felt through palpation,, it doesn't necessarily mean there is a "slipped disc"



After elimination of all other possible serious causes (fracture, tumour, malformation etc.), pain in the dorsal region can often be seen as the result of a global imbalance of the spinal column (secretary's syndrome)



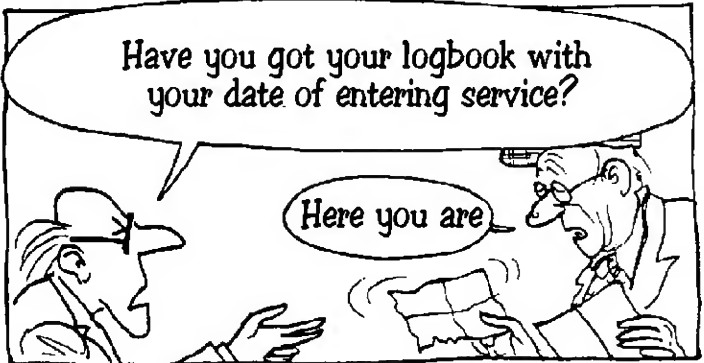
I can't understand it, I've always led a healthy and active life without excess. I've been careful with my discs, menisci and joints but look at the terrible state I'm in now!

Hmm...



Have you got your logbook with your date of entering service?

Here you are



Eh! I'm amazed you can still walk!



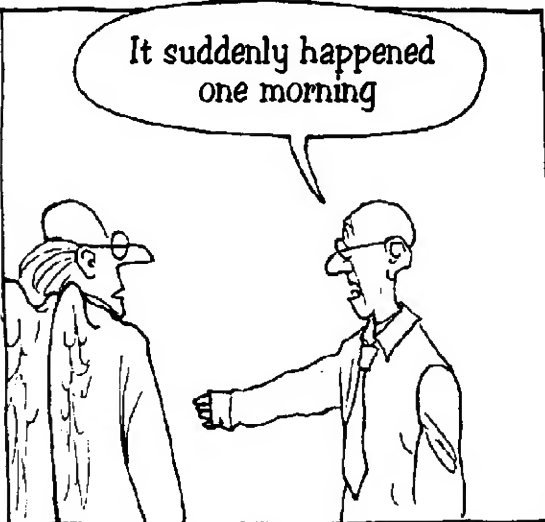
ARTHRITIS

I can't lift this arm anymore though

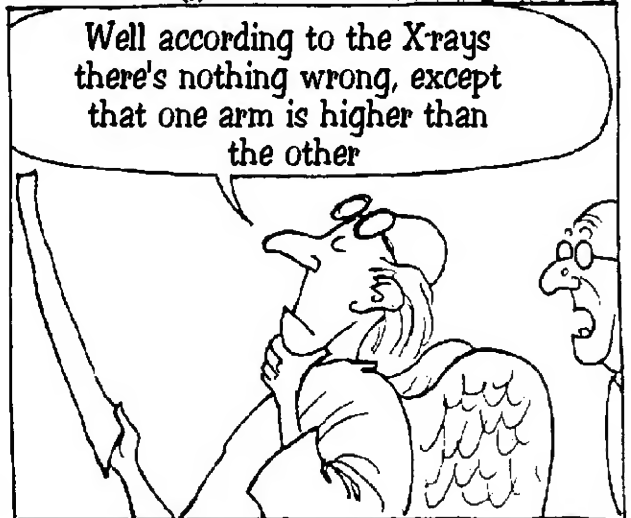


I've told you over and over again, when you create an animal you have to think about a corresponding predator otherwise this sort of thing happens

It suddenly happened one morning



Well according to the Xrays there's nothing wrong, except that one arm is higher than the other

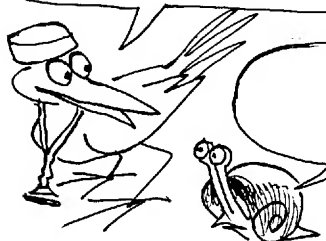


Aie!

You've lost angular amplitude.
Your articulation is badly
lubricated. Your articular
capsule has shrunk and the
ligament of your supraspinatus
is very inflamed

Do I need an operation?

Normally, before we put you on the operating table, for a shoulder,
knee or back, we like to see if AQUAGYM can get things back to
normal more gently. The human body has great powers of recovery
which we often underestimate



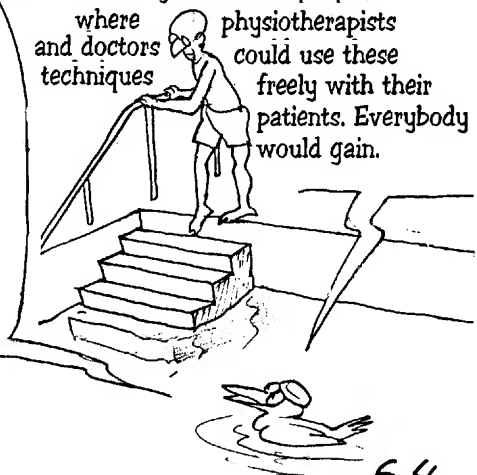
So why don't doctors send their patients
to swimming pools more often?

Because the triangle "doctor-
pharmacist-physiotherapist"
has to function...the
installation of a swimming pool
is too costly for a physio or
even a group of physios. However
in rheumatology centres recovery
always involves progressive
re-education in a pool

In towns, the SOCIAL SECURITY
system should help town councils
create small annex pools that
are free for injured or old people,

where
and doctors
techniques

physiotherapists
could use these
freely with their
patients. Everybody
would gain.



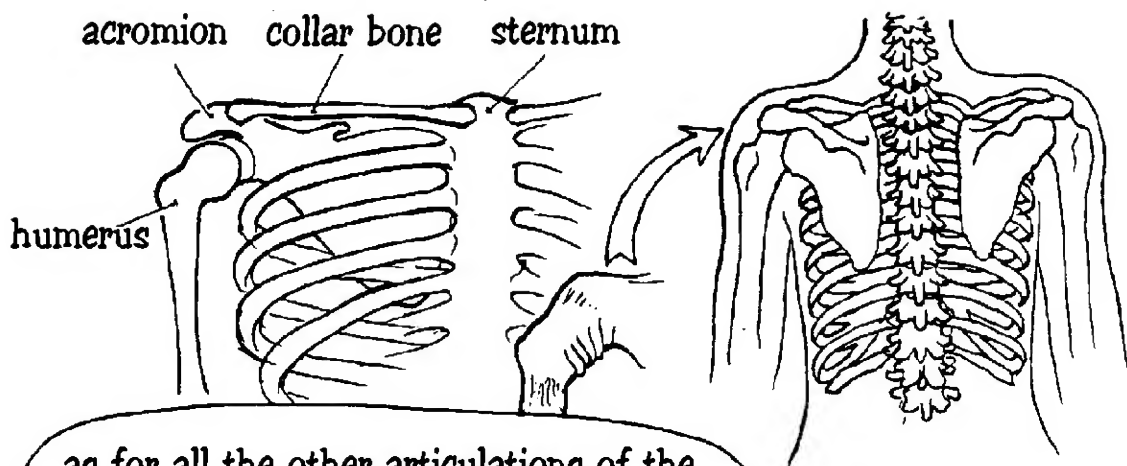
Much better, I'm
recovering centimetre
by centimetre

Articulations **MUST** work otherwise they will
degenerate. Sedentarity **IS** a danger. An
ideal situation is a swimming pool where
movement can be made without effort or pain.

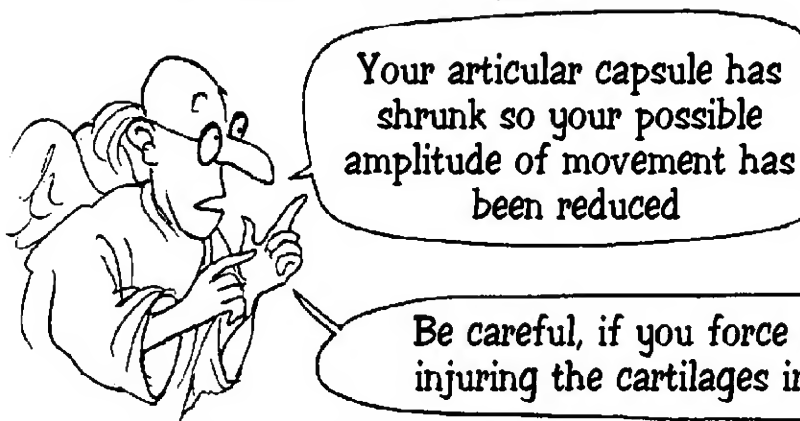
For arthritis in the shoulder the
damaged arm is assisted by the fully
functioning arm even when "on dry
land", still using the good arm to
help movement of the injured arm,
until complete recovery (**FIRST** though,
there has to be complete recovery of
angular amplitude)

There are special cushions filled with small balls that can be warmed in
a microwave and which are quite effective at easing pain and treating
these rheumatic problems

My arm is getting better
but I've got a pain here...

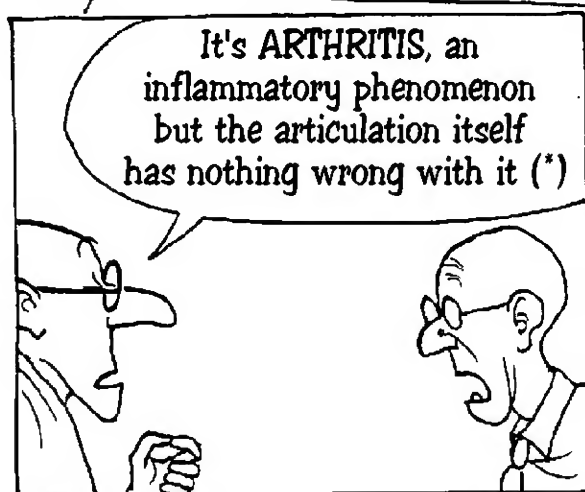


as for all the other articulations of the body, that of the humerus-shoulder blade is enclosed in an articular capsule containing SYNOVIA, the natural lubricant. As this is the most mobile articulation of the body, its articular capsule has "reserve folds" on its lower part thus allowing the arm to be raised.

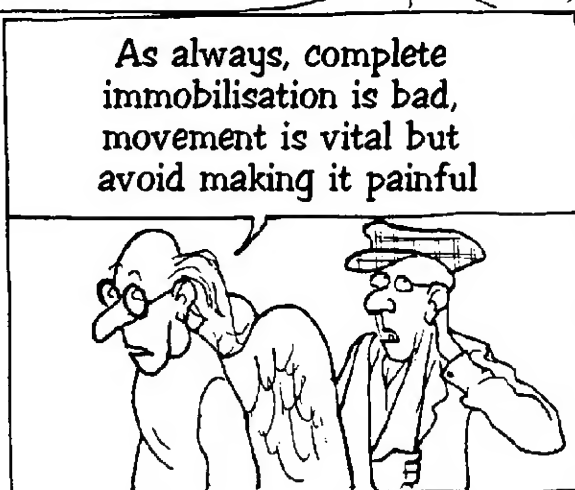


Your articular capsule has shrunk so your possible amplitude of movement has been reduced

Be careful, if you force it you risk injuring the cartilages irremediably



It's ARTHRITIS, an inflammatory phenomenon but the articulation itself has nothing wrong with it (*)



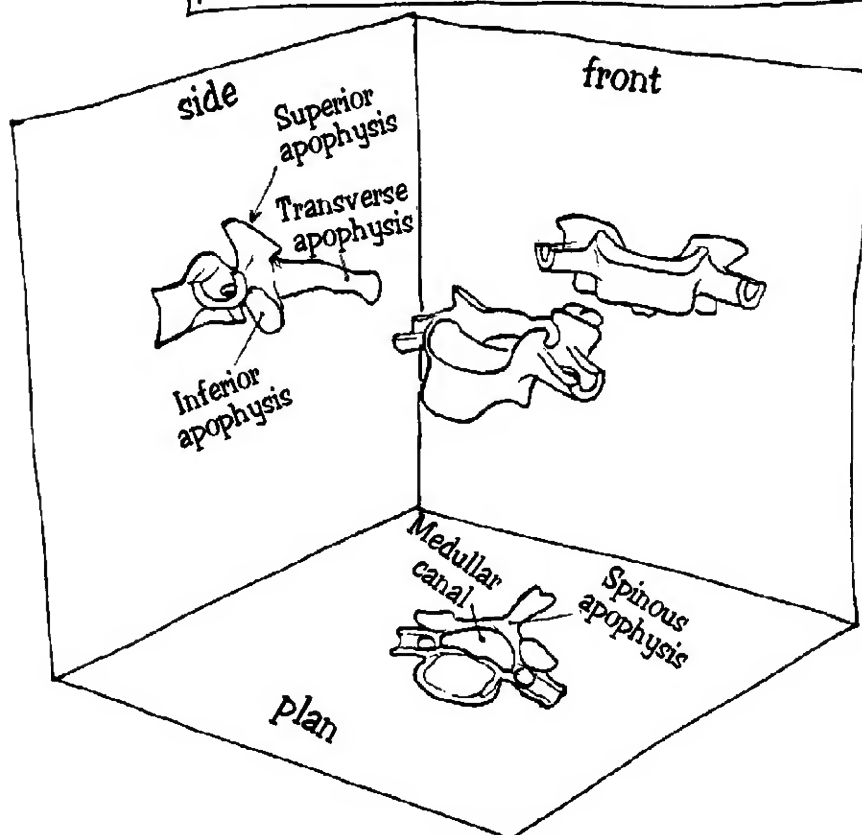
As always, complete immobilisation is bad, movement is vital but avoid making it painful

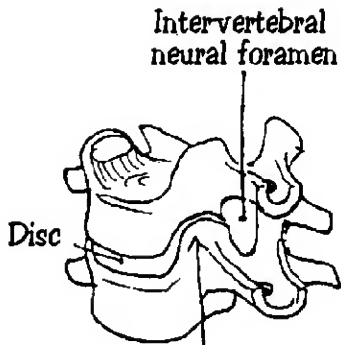
(*) It's called scapulo-humeral periarthritis and is frequent after the age of 50, especially among women.

OSTEOARTHRITIS

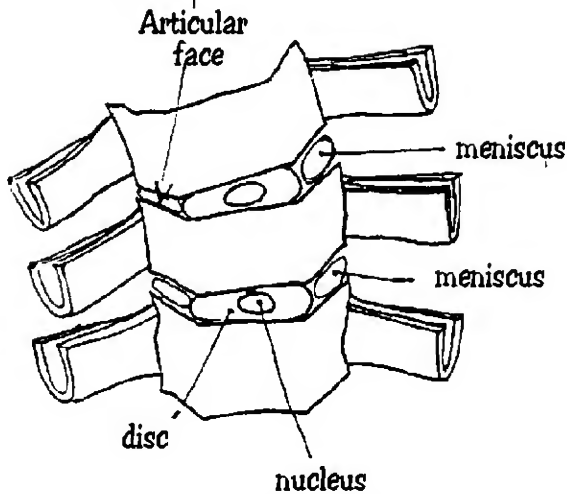


CERVICAL VERTEBRA

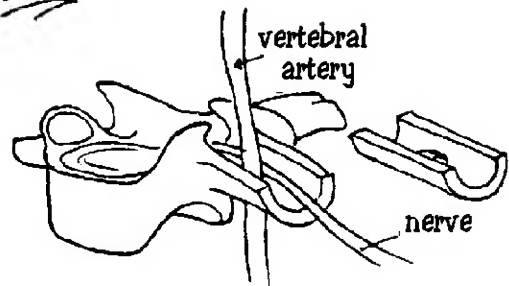




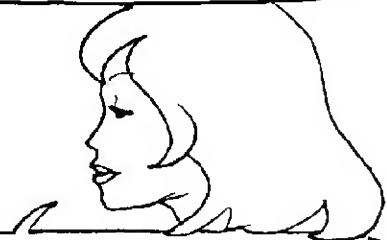
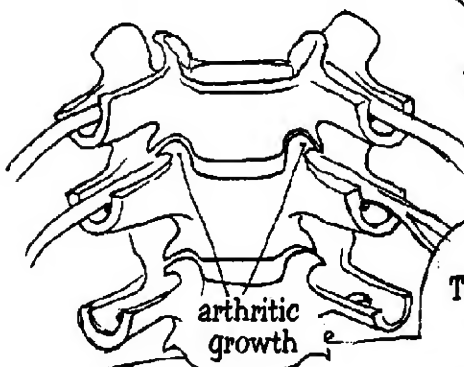
This is how the cervicals are piled on the discs. They have articular faces on each end which will limit the head's inclining movements laterally. These are the areas on cervical vertebrae that are the most subject to wear



CERVICAL VERTEBRAE (FRONT VIEW)

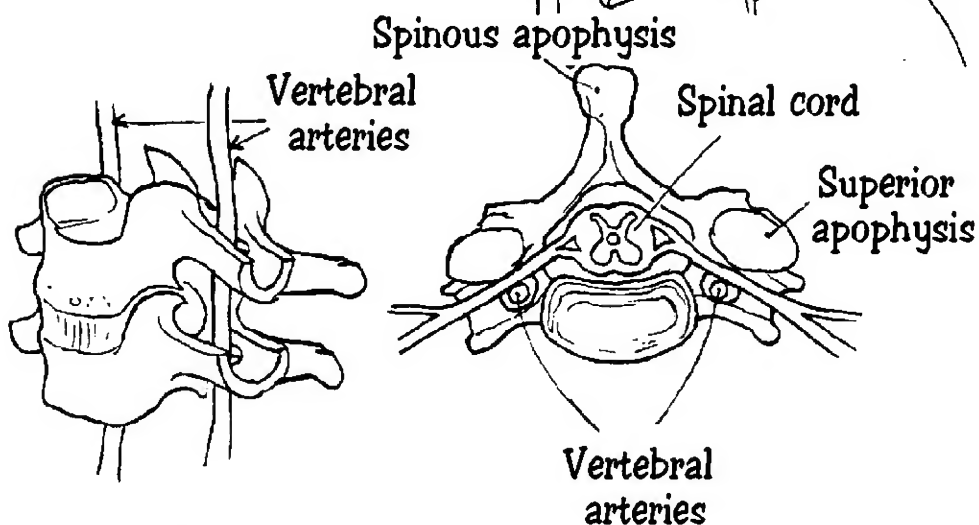


In a fully formed skeleton, any cartilage that has been destroyed by friction will not be replaced. However, the bony tissue is being rebuilt constantly (as can be seen in the automatic healing of fractures). When there is wear on a cartilage, there is increased pressure on certain parts of the vertebra which reacts by developing bony growth in a fairly unpredictable manner, this gives rise to the phenomenon of OSTEOARTHRITIS



The nerve roots come out of the spinal cord through channels in the bone. It is easy to see how osteoarthritis tends to progressively block these openings for the nerves. This generates local pain which can gradually spread into the arms and the hands

When I turn my head I
see little lights dancing
in front of my eyes



We can also see on these drawings
how the vertebral arteries run
along this cervical column



With your restricted nerve passages, when you
turn your head you pinch the artery and reduce
irrigation to your brain. It isn't serious,
look in front of you more often

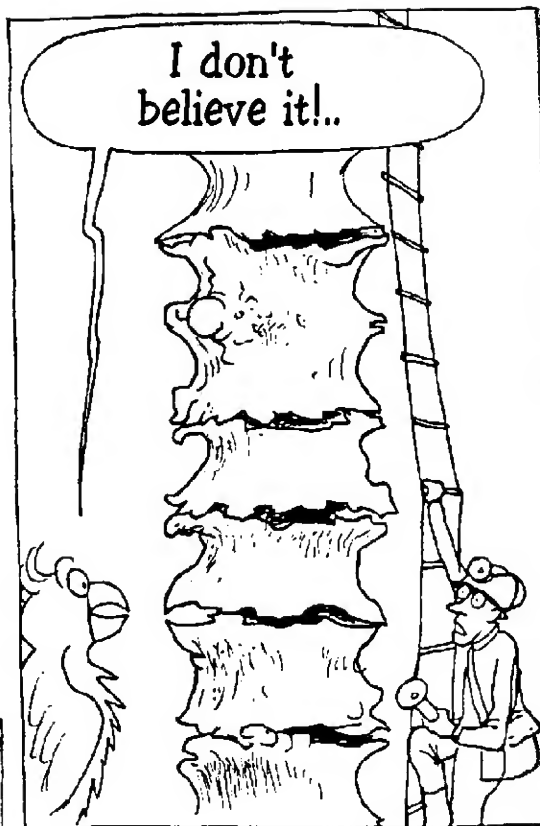
Lets have a look
at your lumbar
and dorsal column



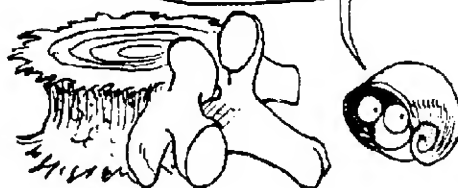
Good lord!..



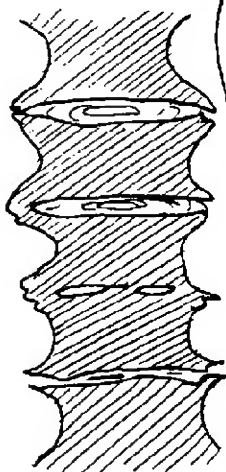
I don't
believe it!..



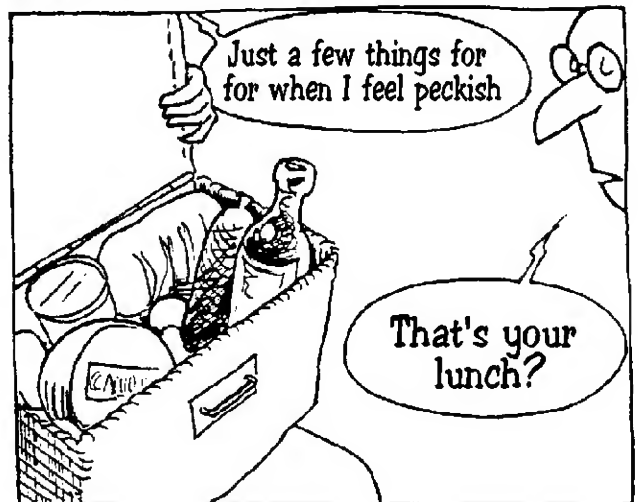
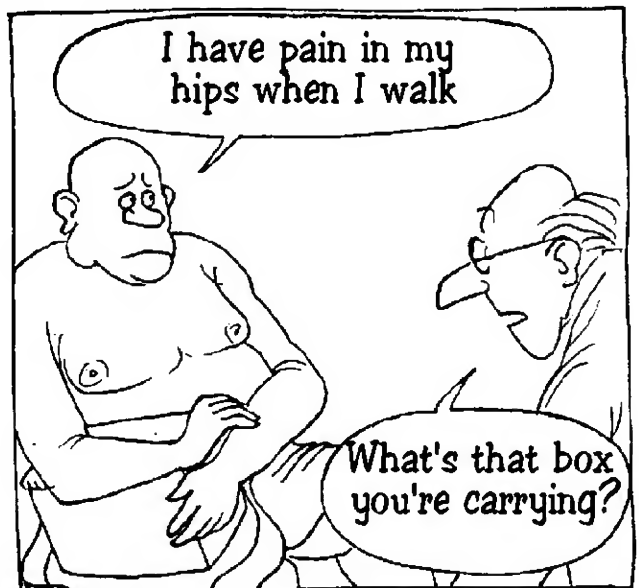
Pretty huh?

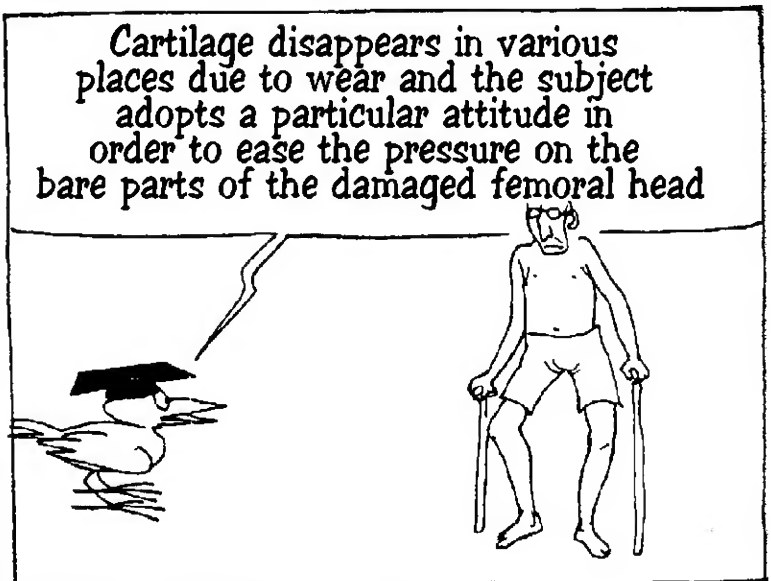
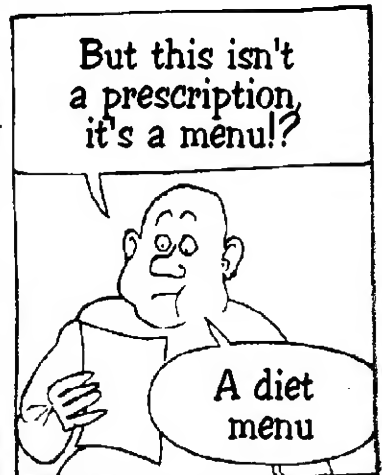
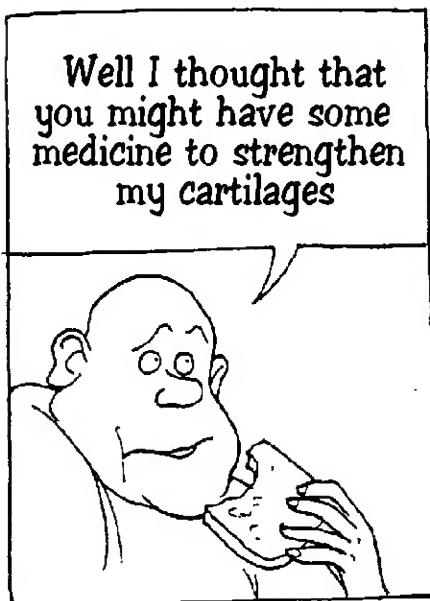
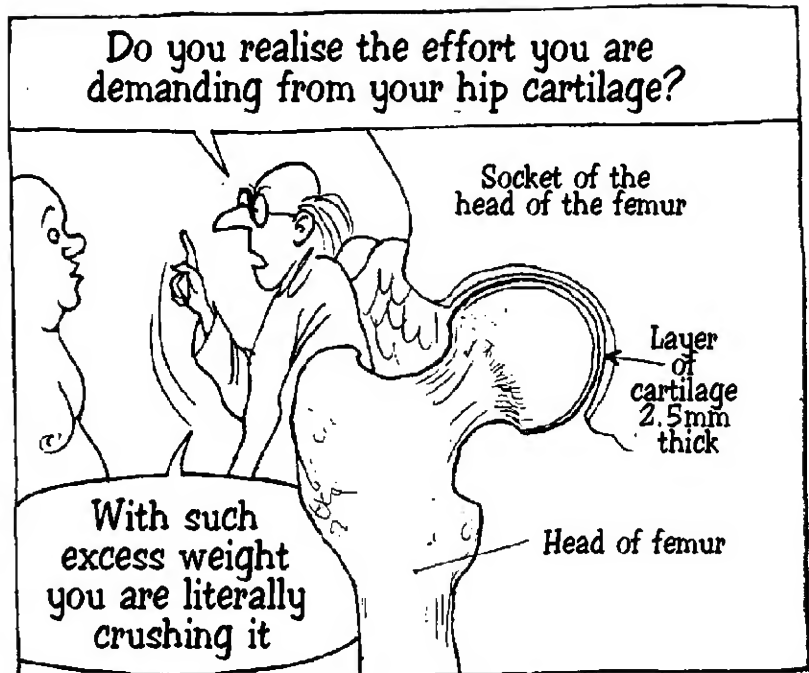


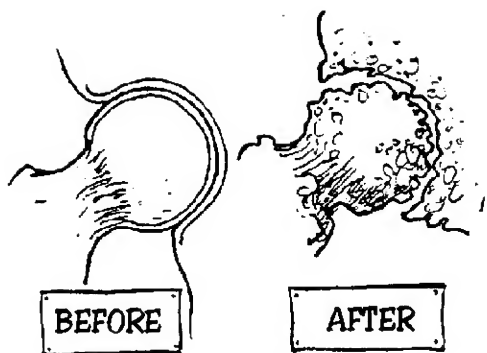
The **OSTEOARTHRITIS** phenomenon develops
with the age of the bony protuberances,
also called **PARROTS BEAKS**. They can
sometimes join up which causes the
vertebrae to fuse together (which isn't
necessarily painful)



Disc degenerescence is what causes
people to become shorter with age

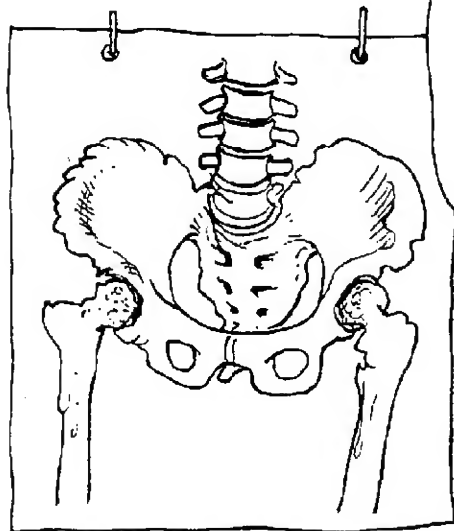






In the final stage of wear, only one solution remains

you change it, change the femur

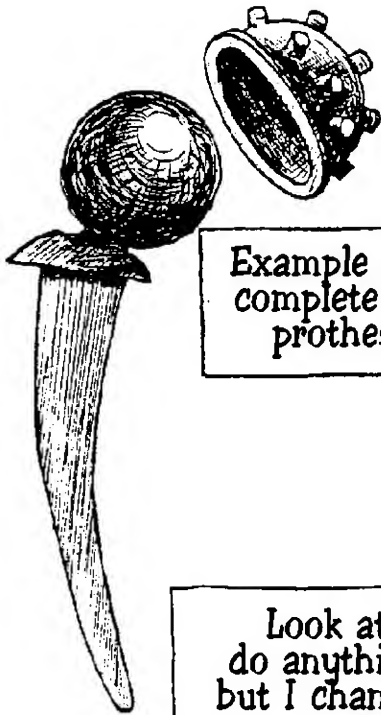


The hip joints are cooked. No cartilage left, worn femoral heads. Their sockets are worn too so there is permanent, wasting pain

And?

Boss, what if we changed some parts?

Show me



Example of a complete hip prosthesis

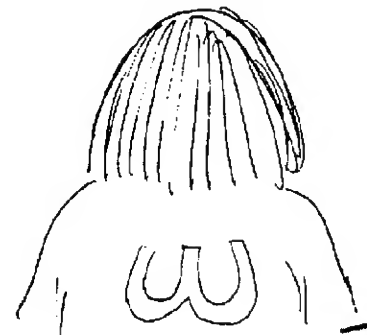
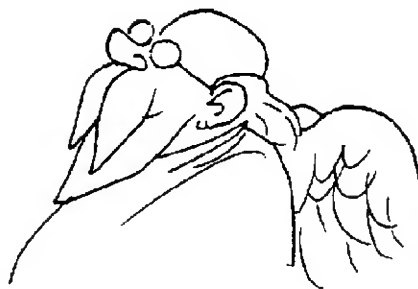
It's the only intervention on the articulation that completely removes the pain and gives acceptable mobility to the hip and allows almost normal activity for the patient

Look at the little old man of earlier. We couldn't do anything about his neck, his back or his shoulder but I changed both femoral heads and now he doesn't stop riding his bike.



In short, he's as good as new

He got up the day after the hardware had been put in and the ligaments sutured and found good articular mobility. In the beginning though he had to avoid situations where a simple wrong movement could have caused the luxation of his prosthesis



EPILOGUE

All the same, all these articulation problems are a nuisance don't you think?

No no, we have THE solution. thanks to technology, man can go and live in space

and up there, no problems, disappeared! They'll be completely weightless

Interesting project

PROJECT? But my dear fellow, they leave every day by the charter load

Space, that's the future of man. When they live in enormous orbital villages they will finally be free from slipped discs and sprains

Six months later...

